This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

LANE

MEDICAL LIBRARY

GIFT
Dr. Grant Selfridge

SURGICAL EMERGENCIES

A TEXT-BOOK OF SURGERY FOR PRACTITIONERS OF MEDICINE

I

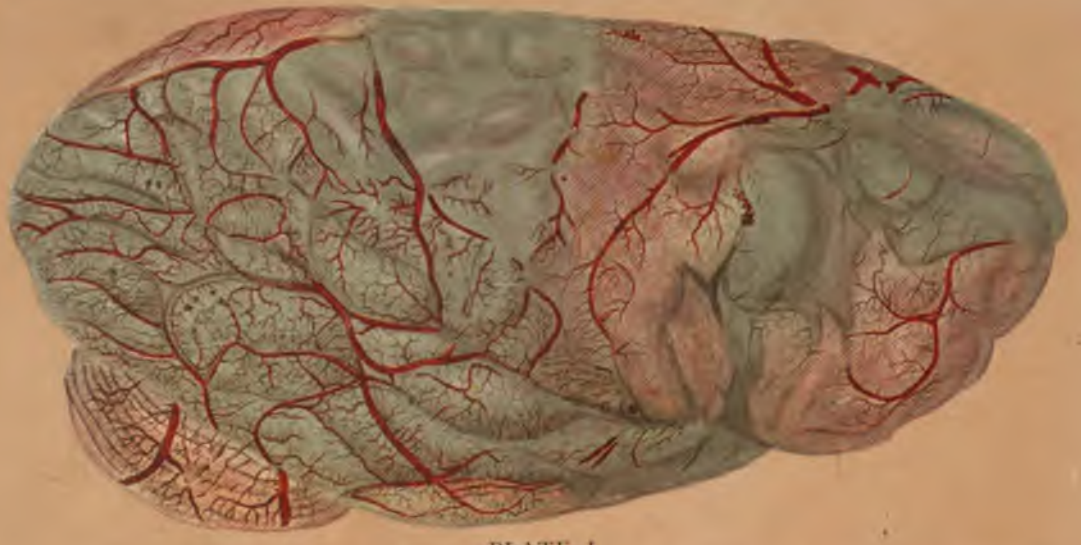


PLATE I

CEREBRITIS.—This is a classical picture of cerebritis going out probably from infection in the sinuses, the result either of middle-ear disease or infected compound fracture. The greenish areas are bloodless, and the surrounding veins are plainly filled with infected thrombi. The hopelessness of any surgical interference in such a condition as this is easy to recognize. It is the duty of the physician to prevent this irremediable condition. Reduced slightly from Lebert, H.; Traité d'anatomie pathologique général et spéciale. Paris, 1857.

SURGICAL EMERGENCIES

THE
SURGERY OF THE HEAD

BY

BAYARD HOLMES, B.S., M.D.

PROFESSOR OF SURGERY IN THE UNIVERSITY OF ILLINOIS, PROFESSOR OF CLINICAL SURGERY IN THE AMERICAN MEDICAL MISSIONARY COLLEGE, CHICAGO, ATTENDING SURGEON THE CHICAGO BAPTIST HOSPITAL

NEW YORK
D. APPLETON & COMPANY
1903

COPYRIGHT, 1903
BY BAYARD HOLMES

LANE LIBRARY

M521
H74
1903

CONTENTS

CHAPTER I PAGE

CONGENITAL MALFORMATIONS OF THE HEAD - - 1

CHAPTER II

CONGENITAL MALFORMATIONS OF THE MOUTH AND FACE. HYDROCEPHALUS. MICROCEPHALUS. HYPERTROPHIES - - - - - - - 13

CHAPTER III

INJURIES OF THE HEAD AND FACE - - - 47

CHAPTER IV

FRACTURE OF THE SKULL - - - - - 78

CHAPTER V

CEREBRAL LOCALIZATION. CRANIAL TOPOGRAPHY. CONCUSSION, CONTUSION, AND LACERATION OF THE BRAIN - - - - - - - - 150

CHAPTER VI

COMPRESSION OF THE BRAIN - - - - - 167

CHAPTER VII

ABSCESS OF THE BRAIN. NASOPHARYNGEAL ADENOIDS. MIDDLE-EAR DISEASE - - - - - - 207

CHAPTER VIII

OTITIS MEDIA - - - - - - - 247

46002

CHAPTER IX PAGE

ABSCESS OF THE BRAIN OF OTIC ORIGIN - - 289

CHAPTER X

SIGMOID SINUS THROMBOSIS. EXTRADURAL ABSCESS 309

CHAPTER XI

TUMOR OF THE BRAIN - - - - - 336

CHAPTER XII

EPILEPSY. PACHYMENINGITIS. INSANITY. CEREBRO-SPINAL MENINGITIS - - - - - 393

CHAPTER XIII

EMPYEMA OF THE ACCESSORY SINUSES OF THE NOSE 423

CHAPTER XIV

THE PAROTID GLAND - - - - - 457

CHAPTER XV

FACIAL NEURALGIA - - - - - 472

CHAPTER XVI

CARCINOMA OF THE TONGUE - - - - 486

CHAPTER XVII

INFECTIOUS DISEASES OF THE FACE AND SCALP - 512

CHAPTER XVIII

TUMORS OF THE FACE AND SCALP - - - 534

CHAPTER XIX

SURGICAL DISEASES OF THE ORBIT - - - 547

LIST OF ILLUSTRATIONS

FIG.		PAGE
1	Aplasia Cranii	2
2	Condylo-Squamosal Suture	3
3	Location of Cerebral Hernias	4
4	Meningocele of the Occipital Region	5
5	Meningo-Encephalocele of Naso-Frontal Region	5
6	Diagram Showing the Use of the Harelip Pins	6
7	Meningocele	8
8	Cervical Spina Bifida	9
9	Curve Showing Frequency, Relative to Age, of Congenital Malformations of the Head	11
10	Anomalous Conditions of the Occipital Region	12
11	Mouth of Human Embryon of Thirty-Five Days	13
12	Mouth of Human Embryon of Forty Days	13
13	Possible Congenital Fissures of the Face	14
14	Partial Harelip	15
15	Complete Harelip	15
16	Complete Harelip	15
17	Double Harelip	15
18	Double Harelip with Projecting Teat	15
19	Median Cleft of the Upper Lip	15
20	Oblique Fissure of the Face	16
21	Median Cleft Nose	16
22-24	Gräfe's Circular Incisions for Freshening Tissue	20
25-26	Methods of Incision in Plastic Operation for Harelip	21
27	v. Bruns' Curved Incision	22
28	Diebenbach's Plastic Operation	22
29	Cleft Uvula	24
30	Complete Cleft Palate and Double Harelip	24
31	Left-Sided Cleft Palate	24
32	Double Cleft Palate	24
33	Wire Suture in Cleft Palate	26
34	Brophy's Wire Suture in Cleft Palate	27

FIG.		PAGE
35	Method of Rendering Inactive the Tensor Palati Muscle in Cleft Palate Operation	29
36	Congenital Hypertrophy of Face	44
37	Curve Showing Age on Admission of Patients Treated in Cook County Hospital During Six Months	47
38	Curve Showing Frequency of Scalp Wounds Relative to Age	49
39-40	Complete Removal of Scalp	57
41	Nerves of the Face and Side of the Head	64
42-43	Chiloplastic Operation in Gunshot Injury	68
44-45	Method of Reducing Fracture of the Zygoma	73
46	Sinuses of the Dura Mater	78
47	Sinuses of the Base of the Skull	79
48	The Base of the Skull	80
49	Curve Showing Relative Frequency of Fractures of the Vault	82
50	Veins of the Diploë	83
51	Outer Aspect of Left Hemisphere of Brain	97
52	Section of Brain on a Level with the Corpus Callosum	98
53	Extravasation of Blood into the Sheath of the Optic Nerve	134
54	Motor Centers on Outer Aspect of Cerebral Hemisphere of the Monkey	151
55	Motor Centers on Mesial Aspect of the Cerebral Hemisphere of the Monkey	152
56	Location of the Fissure of Rolando	156
57	Locations of Hemorrhage from the Middle Meningeal Artery	174
58	Extradural Clot	181
59	Trephine Openings for Hemorrhage from the Meningeal Artery	189
60	Curve Showing Frequency of Brain Abscess Relative to Age	208
61	Chart of Temperature, Pulse, and Respiration in a Case of Traumatic Cerebral Abscess	227
62	Schematic Representation of Depressed Fracture of the Skull	234
63	Pulse and Temperature Record in a Case of Brain Abscess, Following Depressed Fracture of the Skull	235
64	Encapsulated Abscess in Centrum Ovale of Right Cerebral Hemisphere	237

FIG.		PAGE
65	The Facies in Nasopharyngeal Adenoids	240
66	Corrosion Preparation of the Right Ear	257
67	Eustachian Tube of a Nine-Months-Old Child	258
68	Section Through the Temporal Bone	260
69	The Left Middle Ear and Its Appendages, Viewed from the Medial Side	261
70	Vascular Canals of the Pneumatic Cells of the Middle Ear	262
71	Acute Subperiosteal Squamo-Mastoid Abscess	278
72	Occipital Bone Showing Course of Lateral and Sigmoid Sinuses	310
73	Temperature and Pulse Record in a Case of Sigmoid Sinus Thrombosis	319
74	The Veins and Sinuses of the Head and Centrum Ovale	324
75	Section Through Osteoporotic Petrosa, in Case of Sigmoid Sinus Thrombosis	325
76	Relation of the Fifth Nerve to the Petrosal and Sigmoid Sinuses	327
77	Diagram Illustrating Relative Frequency of Various Forms of Brain Tumor in Children and Adults	337
78	Table of Brain Tumor in Children and Adults	339
79	Normal Visual Fields for Color in the Right Eye	352
80	Visual Fields for Color in the Right Eye in a Case of Tumor of the Brain	352
81	Section Through Head of Optic Nerve in Choked Disc	383
82	Cross Section of Optic Nerve in Choked Disc	384
83	Endothelioma of Hypophysis	390
84	Section Through the Frontal Sinuses and the Nose	438
85	Kitterman's Method of Locating the Sphenoidal Cells	448
86	Cutaneous Nerves of the Head and Face	473
87	Ratio of Deaths from Cancer and Tumor in the United States During 1890	490
88	Map Showing Relative Number of Deaths from Cancer in the United States	491
89	Diagram Showing Ratio of Deaths from Cancer in Women	492
90	Osteoma of the Orbit	552

LIST OF PLATES

NUMBER		PAGE
I	Cerebritis	Frontispiece
II	Dermoid Tumor of the Nose	43
III	Pulsating Tumor of the Parietal Region	116
IV	Facial Paralysis Following Otorrhea	282
V	Otic Abscess of the Brain	299
VI	Sigmoid Sinus Thrombosis	312
VII	Sarcoma of the Brain	343
VIII	Osteoporosis of the Skull Following Frontal Sinus Disease	444
IX	Parotid Tumor	469
X	Anthrax of the Brow	516
XI	Rhinoscleroma	518
XII	Lupus of the Face	519
XIII	Carcinoma of the Lower Lip	540
XIV	Multiple Sarcoma of the Skull	545

PREFACE

This series of books on the every-day surgery of the human body has been in the course of preparation for a number of years. It omits the surgery of the eye, the ear, the nose, the throat, and other well-established specialties. The plans which I have followed have been modified by my experience in teaching and by consultation with a large number of thoughtful practitioners of medicine. I have tried to place before the reader at the beginning of each chapter the motive for the study of the chapter and some concrete examples of the more important conditions requiring surgical attention. Special care has been given to maintaining a proper perspective, and no attempt has been made to cover the exceptional cases exhaustively. Three distinct kinds of subjects have secured attention: those conditions which are most frequently met with are thoroughly discussed, those that are less frequently met with, but require instant relief, receive the next share of attention; and last of all, those that are of great theoretical importance, though of less frequency, are also fully considered. With the conviction that the reader requires a vivid and harmonious picture, and one which he can never forget, the presentation has been in the form of a continuous discourse. Every possible device is used to secure in the mind of the reader the most intense and lasting impression, and one which insures for the subject an individuality and

integrity which is inconsistent with a dissected and chopped-up discussion.

Probably nine-tenths of all the surgical work which the general practitioner is called upon to perform is confined to one-ninth of the subjects found in an encyclopedia of surgery, and it is therefore unreasonable that the discussion of surgical rarities should overshadow that of the every-day emergencies of the average practitioner and confuse him by their bulk. A perusal of the proceedings of medical and surgical societies and a cursory reading of the current medical literature gives a wholly distorted picture of the importance of the subjects discussed.

In every chapter I attempt to teach pathology, diagnosis, and proper methods of treatment without any didactic form, hoping thus to secure attention to the spirit of a conscientious clinical investigation, and to establish the habit of exhaustive and systematic study of every case and the habit of making an exclusive diagnosis before any operative procedure is thought of.

The reader's attention is directed to the great advantage of studying the surgery of the head with many anatomical and pathological specimens at hand; and since the supply of these specimens is necessarily limited, the same end may be less effectively attained by consulting the text-books of anatomy and pathology, and reading the literature of the subject in hand in the current medical journals. Carefully reported clinical observations will be found of the greatest possible value in giving unity and vividness to the student's apperceptions. The histories

of such cases might well furnish the first if not the bulk of his accessory reading. Students who have pursued this method* have years afterwards expressed to me their great satisfaction with the vividness and completeness of their conception of the subjects studied, and with the permanency and availability of the knowledge which they retained, and the mastery brought to the test of experience.

It has been very difficult to select a suitable title for this series. The books will contain a full discussion of all those emergencies which the average practitioner of medicine meets in his daily practice; but those unusual and trying conditions which the professional surgeon would understand by the title are passed over briefly.

I wish to express to my various friends gratitude for their encouragement and suggestions, and especially to the students of several successive classes at the College of Physicians and Surgeons, with whom a part of these studies have been prepared and read. I am also under obligations to Dr. H. F. Goodwin, Dr. Rudolph Teschan, Dr. P. Gad Kitterman, Dr. Frank Blatchford, and Dr. Charles Bechtol, who have assisted me in some of the drudgery of this work; and particularly to Mr. J. D. Blything for his unflagging care and interest in reading the copy and proof, and in carrying out various other details in the production of this book.

BAYARD HOLMES.

*The Seminary Method in Teaching Surgery, Jour. Am. Med. Assn., August 8, 1896.

CHAPTER I

MALFORMATIONS OF THE HEAD

Definitions; origin; location; frequency; diagnosis; treatment of pedunculated meningoceles; treatment of sessile cephaloceles; illustrative cases; cephalocele complicating labor; cephalocele of the base protruding into the orbit, nose, pharynx, and maxillary space; anomalous conditions of the cranial bone; literature.

CONGENITAL MALFORMATIONS OF THE HEAD

i. Defects resulting in conditions beyond, or not requiring, surgical treatment. (a) Acephalous monstrosities (see text-book of pathology). (b) Defects and irregularities of cranial bones.

ii. Defects subject to surgical treatment. (a) Cephalocele: a generic term applied to any tumor external to the skull, containing elements belonging within the skull.

1. Meningocele: dura only.

2. Encephalocele: dura, pia, and cerebral or cerebellar substance.

(b) Cleft palate, and fissures about the face.

CONGENITAL MALFORMATIONS OF THE HEAD

The congenital malformations of the head are usually explained by the theory of arrest of development. They should be studied in connection with congenital malformations elsewhere in the body. They may be

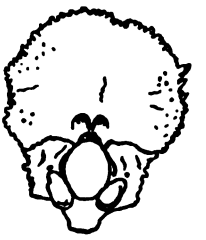
due to failure of the neural canal to close completely (cephalic spina bifida), or to failure of some part of the bony structure of the head to meet the opposing part in the middle line. On the other hand, it is possible that in some cases an unusual intrameningeal pressure develops after a nominal dorsal union has taken place, and that a hernia results at the weakest point. The idea which prevails among the common people that these defects are due to "marking" or "maternal impression" is not worthy of the slightest consideration. The ill health of the mother may have something to do with the arrest of development of the fetus, and intra-uterine injury may produce errors of development; but even these causes have rarely been demonstrated. Obviously they are never hereditary.

1. Aplasia cranii. (Vrolik.)

Some of these defects show themselves as congenital hernias of the brain or of its membranes. When the defect in the skull permits the brain and its coverings to protrude under the skin, the hernia or tumor is called an encephalocele. When the defect in the bone is smaller it permits only the dura to protrude, forming a tumor filled with cerebro-spinal fluid. This tumor is called a meningocele, or hydrencephalocele. When the contents of the tumor are unknown or unnoticed it is called a cephalocele. Sometimes the pedicle of the tumor is cut off by the growth of the skull, leaving the meningocele separated from the arachnoid spaces. (Newfeld.)

Like all other congenital malformations and errors

of development, cephaloceles are supposed to be transmitted to the offspring, though naturally few observations are found in the literature of hereditary cephalocele.



2. From the skull of a girl two years and three months old, showing the condylo-squamosal suture, one-fourth natural size. (Zaaijer.)

These hernias are found in order of frequency, (1) on the back of the head, (2) in the region of the nose, (3) less often in the region of the sagital suture, or in the region of the smaller fontanelle, and (4) least often of all in the the region of the mastoid, or the condylo-squamosal suture. This suture is not often recognizable after the second or third year, but a defect sometimes remains great enough to allow a meningocele to persist. Occasionally meningoceles appear in the nose, either through the ethmoid or through the sphenoid, and they have been inadvertently removed as polypi.

Cephalocele is relatively rare, according to Vines one in 5,000 births, but this is probably entirely too high a ratio, unless still-born infants are included. The occipital and frontal hernias are most common. In 85 cases 44 were occipital, 41 frontal or sincipital. Houel collected 93 cases of cephalocele, of which 63 were occipital, 16 naso-frontal, and the remaining 9 along other sutures of the skull. Gibbs, in 5,000 births, noticed only one meningocele; Winckel, in 12,000, only 3; Trélat, in 12,900, only 5. It is a little more common in girls than in boys.

When we compare the frequency of these errors in development with the total number of malformed chil-

dren, the number of cephaloceles seems very small. One child in each 5,000 births is malformed, or 20 children of every 100,000; 19 of these 20 children are not viable, and most of the remainder require surgical treatment.

3. Diagram showing the location of hernias through the skull in 178 cases (six scattered).

The locations of congenital defects in the skull resulting in cephalocele are easily accounted for by errors in the development of the head in embryonal life. The actual cause of these malformations is unknown. They seem to be related to congenital hydrocephalus and to increased intracranial pressure.

These errors result in many grades of malformation, the most of which are unpromising subjects for surgical treatment. The osteal defect may be so small that only a capillary tube of meningeal membrane protrudes and expands under the scalp into a cavity filled with meningeal fluid. This membrane often undergoes a myxomatous degeneration. The cyst is usually pedunculated and of considerable size, even exceeding the dimensions of the head itself. The skin over the tumor is often very thin, and always becomes so in the course of the first few weeks or months of life.

The diagnosis of cephaloceles is not often difficult. They are always congenital, though they may not be discovered until some weeks after birth, and may begin

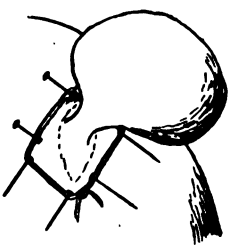
to grow only after several months or years. The defect in the skull at the base of the tumor can sometimes be detected with the fingers. The tumor pulsates and becomes more tense when the child cries, strains, laughs, sneezes, or coughs. Meningoceles are translucent, while encephaloceles are opaque in proportion to the amount of brain substance they contain. In cases of encephalocele the defect in the skull is usually great enough to be easily detected. Caput succedaneum and hernias of the brain from fractures of the skull might possibly be taken for congenital cephalocele of the vault. In the cephaloceles of the base the diagnosis is so difficult as to be almost impossible. Here they are mistaken for polypi, or they are entirely overlooked and the unfortunate child dies of a meningitis which arises through infection in the nose.

4. Meningocele of the occipital region. (Kirmisson.)

The prognosis of cases left to themselves is very grave, if not absolutely unfavorable. The tumor increases in size until the skin breaks through from pressure atrophy or accident, the meninges or the protruding brain becomes infected, and the child dies of suppurative meningitis. In a few cases, however, the tumor is small and well protected, and the patient lives to adult life. Wallman's case was a man fifty-eight years of age.

5. Meningo-encephalocele of naso-frontal region. (Kirmisson.)

Pedunculated meningoceles are easily treated by subcutaneous ligature of the pedicle and removal of the cyst. The pedicle is then introverted and pushed through the skull. The opening in the bone is best closed with a bone-flap cut from the adjoining skull with a strong, sharp knife. This flap should be swung over the defect and the scalp completely united. The greatest danger lies in hemorrhage, which infants endure very poorly. It should be prevented by every means possible. To prevent hemorrhage the pedicle may be surrounded by a row of lock-stitches, as practiced by Tillman and Frank, or the pedicle may be removed between four harelip pins surrounded with strong silk. The pins are thrust through the scalp some distance from the pedicle on each side, fencing it in in a little square. Stout silk is then wound about the pins, making the square bloodless. Inside the pins the incision is made about the pedicle and the dural portion tied off with fine catgut, the tumor removed and the pedicle pushed through the skull. A chip of the bone is then partially cut off the adjoining skull and turned round over the defect. The scalp is then brought firmly together by stitches placed far from the edges of the wound (tension stitches) and by fine stitches close together, joining the edges firmly (coaptation, continuous stitches). The pins are removed as their places are taken with stitches. The suture is



6. Diagram showing the use of the harelip pins.

then covered by an antiseptic dressing of a non-irritating kind—boric gauze, for example, because infants and children are easily poisoned by iodoform and sublimate. The dressing should be held on snugly and firmly with rubber adhesive plaster.

The cephalocele is sometimes sessile and the defect in the skull extensive. The tumor then usually contains not only the meninges, but also the cortical substance of the brain. Removal of the tumor and repair of the skull is then a very difficult and dangerous operation. In such cases a portion of the fluid can be removed and the tumor treated by compression. Not much can be expected of such treatment, except a little time. If the child lives a few weeks and gets strong an osteoplastic repair of the defect must be undertaken. A large flap is made, which will be supplied with blood. A part of this flap must come from the tumor. The flap should not have its suture line over the defect, but as far as possible from it. The flap must uncover a portion of bone to be resected to cover the defect. The operation must be bloodless. The bone-flap must next be loosened up with a strong, slightly curved-on-the-flat cartilage knife. The scalp over the dura covering the tumor is then very carefully skinned off. The bone-flap is swung around over the tumor and pressed down until its edges can be sewed with silver wire to the edges about the defect in the skull. The skin-flap must be brought over and sewed down and all covered with a closely fitting dressing.

W. W. Keen* reports a case of meningocele and operation in a boy of three years. He was one of

*International Clinic, October, 1891.

four otherwise healthy children. There was no history of similar malformation in the family. The tumor on the back of the head was about as large as a hickory-nut. It was one inch in diameter at birth, and one and three-quarters inches in diameter when operated on. During the first year the tumor was very sensitive, but later it could be handled with impunity. It was located at the open posterior fontanelle. It pulsated with every heart-beat. The pedicle of the tumor was approached by an elliptical incision and found to be only three-eighths of an inch in diameter, though the skull defect was an inch and a quarter in diameter. There was no cerebral tissue in the pedicle. It was ligated in three parts and the tumor cut off. The bone defect was filled in by a decalcified bone-plate. This was covered by the scalp and closely sewed down without drainage. For four days there was a loss of some cerebro-spinal fluid, and two days later a little pus appeared under the dressing. Suppuration continued for ten days, when the wound was opened and the remnant of decalcified bone removed. The wound was carefully scraped out and swabbed with carbolic acid, packed with gauze and allowed to heal by granulation. The patient recovered perfectly.

7. Meningocele. (Keen.)

Keen also describes a case of cervical spina bifida which he operated on, with death on the thirty-first day.

Cephalocele has been mistaken at birth for a bag

of waters and the tumor opened before the patient was born. D. N. Eisendrath reported such a case (Chicago Medical Recorder, Vol. xiv., page 435).

The babe was twenty days old when presented before the Chicago Medical Society. In the occipital region was a marked hernial protrusion of the brain. The case was one of encephalocele, and not one of meningocele. The convolutions of the cerebrum could be plainly seen. In this case the midwife thought that the hernial tumor was the bag of waters and proceeded to cut it. When the child was sent to the Michael Reese Hospital there was a large flap of skin exposing the brain.

8. Cervical spina bifida. (Keen.)

Cephaloceles protruding through defects in the base of the skull present themselves in the pharynx, in the orbit, or within the space made by the muscles of the pharynx and the jaw. They have been termed by Fenger spheno-pharyngeal, spheno-orbital, or spheno-maxillary cephaloceles. One of these tumors, which had protruded through the mouth and hung out upon the chin and sternum, was operated upon by Lichtenberg. It was as large as the fist. The patient suffered at the same time from harelip and cleft palate. The tumor arose from the right wall of the nasal cavity. The patient died from the operation, and the autopsy developed the fact that it was a cerebral hernia. Such terrible cases as this are not often met with, but Meyer suggests that possibly the

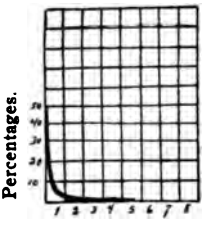
smaller ones are more common, and that they are mistaken for nasal polypi. Czerny operated upon a child three days old for a basilar cephalocele. The left ala nasi was broadened and pushed upward by a soft, elastic, pedunculated, transparent tumor as large as a hazelnut, half of which protruded through the opening in the nose. The nose was covered with dried crusts. It did not increase in size when the child cried. After the removal of the tumor the child lived several weeks and died from marasmus without meningitis. Tillaux reports the case of a man who suffered from a profuse watery nasal discharge for twenty-four hours after the removal of a nasal polypus. Analysis showed that this fluid was identical with cerebro-spinal fluid. Fenger, himself, operated upon a coachman twenty-nine years old for a nasal obstruction present since childhood. Suspecting a nasal cerebral hernia, he aspirated with negative results and undertook the removal of the obstruction with a snare. A gush of cerebro-spinal fluid cleared up the diagnosis, and the patient was removed to a hospital, where upon the following day, after resection of the upper jaw, the pedicle was ligated and the jaw replaced. The patient made a good recovery.

The diagnosis of basilar hernias of the brain is always attended with the greatest difficulty. Fenger points out the fact that widely separated eyes and a very high attachment of the pedicle of the supposed polypus are suggestive of encephalocele. Aspiration and subsequent operation alone can establish the correct diagnosis.

The chemical and physical constituents of the aspi-

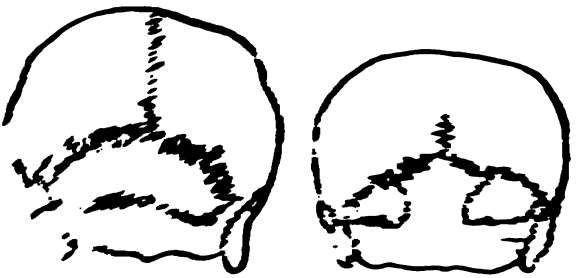
rated fluid ought to lead to the recognition of meningocele. The most reliable clinical test is the discovery of sugar. Grape sugar in small, but recognizable, quantities is present in all cases so far reported.

The prognosis of basilar cerebral hernia is more unfavorable, if possible, than similar conditions on the brow or occiput. It is probable that many cases succumb to meningitis following nasal infection without diagnosis. Fenger's case illustrates the fact that a person may advance to adult life without fatal accident, but the rarity of similar cases in the laryngologic literature leads to the conclusion that it is quite exceptional. The prognosis is bad. The prognosis, after operation, cannot be stated on account of the limited experience of surgeons. It seems, however, that the best results would be obtained by early and radical extirpation. Cases are observed in which more than one cephalocele appear in the same person. Lysenkoff reported three cases in 1895, treated by osteoplastic closure. The two tumors came out at the root of the nose, through the perpendicular plate of the ethmoid. These patients were eighteen years, two months, and one year and three months old respectively. The first and second cases recovered perfectly, but the third died of suppurative meningitis.



9. Curve showing the age of the patient when applying for relief for congenital malformations of the head.

Incomplete formation or anomalous conditions of the skull are also met with occasionally, and must be



LITERATURE

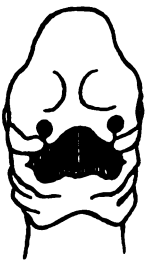
The literature of this subject should be studied in the volumes and journals of obstetrics, from the volumes and journals of embryology, and from the volumes of pathology. Any special subject can be found by reference to the Index Catalog of the Surgeon General's Library, to the Index Medicus, and to the Cumulative Index to the Indices of the Philadelphia Medical Journal, American Medicine, and the Journal of the American Medical Association. The Transactions of the London Pathological Society contain many interesting cases.

CHAPTER II

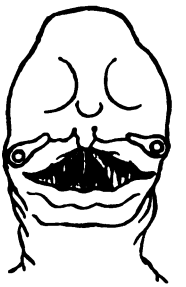
CONGENITAL MALFORMATIONS OF THE MOUTH AND FACE

Cleft palate; description. Various degrees of cleft palate; double uvula, simple cleft palate on one side, on both sides with harelip, with double harelip. Statistics of frequency. Statistics of viability; prognosis as to life, health, sanity, heredity; etiology. Methods of treatment.

The origin of harelip and other fissures about the face can be readily understood by referring to the development of the face of the fetus about the thirtieth



1. Mouth of a human embryon of thirty-five days. (Coste.)



12. Mouth of an embryon of forty days. (Coste.)

to the fortieth days of gestation. It will be noticed that the eye is gradually shut off from the mouth and pharynx by a line which extends along the side of the nose to the lip. This line shows itself first and is afterward met by two lines of union extending from

the nostril downward. The corners of the mouth, which originally extend nearly to the ear, may also fail to close, leaving a fissure in that direction. The possible deformities of the face are represented by the accompanying diagram after Meckel.

13.

The failure of any one of these sutures of the face to unite results in a more or less complete fissure or deformity. Every well-formed upper lip bears the evidence of the union of the two sutures in the two ridges extending from the inner borders of the nostrils downward and making the median depression called the philtrum. In many lips there is a slight notch on one side or the other, showing less complete development on that side. This is a hint of a possible harelip. The cause of this failure to develop normally has been sought for in disease or discomfort of the mother during the fifth and sixth weeks of gestation, in a traumatic injury of the child in the uterus, in too firm pressure of the amnion over the face, and in an unequal or unnatural development of the base of the skull. It is a fact that the most extensive defects in the face are accompanied by adhesions of amniotic bands in these fissures, and there is evidence that they are causative rather than resultant conditions; but it would not seem likely that deformities so produced would be transmitted from generation to generation, both upon the male and upon the female side, as harelip surely is. Although harelip is often accompanied by cleft palate, of which it naturally forms a part, it is frequently found alone, and in varying grades or degrees.

When there is a slight notch in the upper lip in the line of one of the nasal sutures it is termed a partial, lateral harelip (14). When the defect extends to or into the nostril it is termed a complete lateral harelip (15) (16). The greater number of cases of harelip in

14. Partial harelip.

15. Complete harelip.

16. Complete harelip.

adults can be referred to one of these forms, because only such cases are neglected. When the fissure is open on both sides of the lip into the nostrils it produces a condition known as double harelip (17). This is extremely rare, except when accompanied by cleft

17. Double harelip.

18. Double harelip with projecting teat. (v. Bruns.)

19. Median cleft of the upper lip.

palate. The nasal portion with three or four teeth or a cartilaginous mass usually protrudes considerably beyond the lip and apparently at the very end of the nose (18). In a few cases the bony portions of the face are intact, but there is a complete absence of that portion of the lip which should be contributed by the vomer (19).

In many monsters and a few viable children the

corner of the mouth remains open almost to the ear. These are cases of the so-called macrostoma (20). They have little except theoretical interest.

20. Oblique fissure of the face.

In extremely rare cases an analogous fissure is found in the lower lip, usually accompanied by defects in the lower jaw or by other defects in the face. It has been observed in various degrees: as a simple dent in the lower lip, as a fissure extending to the lower jaw, as a fissure extending through the floor of the mouth, and as a complete fissure of the tongue as far back as the foramen cæcum. These defects are observed for the most part in children that are not viable.

There is occasionally seen a fissure along the top of the nose, producing a condition known as dog-nose. It is not usually very symmetrical and is accompanied by an overgrowth of the ethmoid, resulting in a separation of the eyes, the inner corners of which are covered by a fold of skin stretching from the brows to the alæ (21). Occasionally defects in the alæ alone are met with. They are of uncertain origin.

21. Median cleft nose. (Nasse.)

The prognosis of a case of hare-lip, if left to itself, is unfavorable in proportion to its extent. Children with complicated and extensive forms in which there are

cleft palate and defects at the base of the skull live only a few days at most. In less extensive cases the nasal and pharyngeal mucous membranes become covered with scabs and multiplying bacteria, and the respiratory and digestive tracts soon follow in an infective bronchitis or gastro-enteritis. The nourishment of the child with harelip of any grade is necessarily imperfect. Much can be done by careful feeding. Even when the palate is perfect the lip cannot approximate the nipple as well as the perfectly formed lip. The physical difficulty of obtaining nourishment is increased by the neglect which the child is bound to receive on account of its repulsive appearance. Even when the defect is apparently trifling the imperfect nutrition and the mouth breathing result in an exaggeration of all the dangers from which children suffer. The prognosis is bad.

Fortunately most children are brought to the attention of the physician early in life. There is every reason, both from a physiologic and a psychic standpoint, for an early attempt to repair the congenital malformation and give the child a human expression. The greater the defect the earlier should the correction be undertaken. While the nose and mouth are relatively clean there is less danger from infection. During the early days of life the nervous system of the child seems well prepared to withstand traumatic injury. During the first five days of life there is always a loss of weight and strength, and theoretically, if not practically, it would seem better to wait until the child begins to gain again at the end of the first week. Experience, however, shows that operations

may be undertaken immediately after birth with almost an equal chance of success. The dangers of operating are from hemorrhage, from infection, and from narcosis. The new-born infant stands chloroform well, and this danger is probably the least. The danger from infection in the more extensive malformations is considerable, but in the early days of life, and with painstaking asepsis, the risk is not great. The new-born withstand the loss of blood very poorly indeed, and the operation must be made absolutely bloodless. The little patient should be put in a bag and fastened firmly upon an operating board or table with the head hanging backward and downward, so as to prevent any of the antiseptics or the blood and mucous from going into the pharynx and trachea. The operation should be made step by step, and perfect coaptation should be secured so that there will be no possibility of hemorrhage or oozing. The prognosis of recovery from the operation can hardly be stated from the limited statistics at hand, but it is certain that the prognosis is relatively very favorable.

Cleft palate is distinctly a malformation due to arrest of development. Three distinct structures meet to form the roof of the mouth and the hard palate: namely, the two arches of the maxilla, and the vomer—two from the side and one from above, dorsally. A failure of any two of these structures to meet leaves an opening between the nasal cavity and the mouth.

When the cleft is on one side it is said to be a lateral cleft palate (uranoschisma unilaterale). When the cleft extends entirely through the jaw from the

nostrils to the tongue it is said to be complete (uranoschisma). When it extends only part way from the uvula to the incisors it is said to be partial (uranocolobom). The defect may be so slight as to be recognized only as a double uvula, if posterior, or if anterior, as an unusually deep philtrum.

A cleft palate is said to be complicated when other structures take part in the malformation. The most usual complication is harelip, which may be looked upon as a part of a single embryonic defect. Cleft palate is sometimes found associated with lateral fissures of the face, or other malformations not compatible with life. Nearly all so-called monsters have cleft palate and harelip.

The operation for harelip, or harelip and cleft palate, or other malformation about the face, should be undertaken at the earliest possible moment. The best results are obtained when the patient is operated upon during the first month of life. The patient should be prepared by the most careful disinfection of the lip, face, nasal and buccal cavities. The best anæsthetic is chloroform, which should be given upon a frequently renewed sterilized mask, as it is almost sure frequently to come in contact with the operator and his instruments. The little patient should be firmly held in a bag or bag-like bandage, with the head hanging backward over the table, in a good light. The operation must be made absolutely bloodless. This can be done by compression in advance of incision. The compression should be made by the thumbs of an assistant.

There are three distinct plans of operation. In the

first a portion of the mucous membrane is removed and the raw edges are brought together with silk stitches or with harelip pins. In the second such an incision is made about the defect as will permit an obliteration without any loss of tissue; and by the third method a more or less complicated plastic operation is done to meet the requirements of exaggerated cases. The incision for the first operation is varied according to the character of the fissure, as represented in figures 22 and 23. In the second method of operating the incision is made so as to leave the

22 23 24

Circular incisions for freshening tissue, after Gräfe.

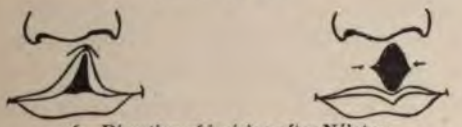
mucous membrane, which is brought down, as in figures 25 and 26. An effort is made to reproduce in this manner the ridge which is found on the outer border of the natural philtrum. The lateral incision is designed to bring the ends of the muscle orbicularis oris in such contact as to give a natural expression to the mouth. Two of the more complicated operations are shown in the figures 27 and 28. When the harelip is accompanied by a cleft palate, the cleft palate should first be closed by the method described as Brophy's, and the harelip either treated at once or upon the removal of the silver wire suture from the palate.

Cleft palate is one of the most common of all viable congenital malformations. A large majority of all

children born with complete cleft palate and harelip die of inanition on account of their inability to nurse. The children with incomplete cleft palate nurse with difficulty, and probably half of them die either of lack of nourishment or of pharyngitis and bronchitis, both of which are apt to befall these children.

25 (*a*) 25 (*b*)

Method of incision after Malgaigne. *a*, after v. Bruns'; *b*, after König's plastic operation.

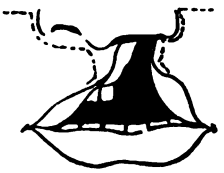


26. Direction of incision after Nélaton.

This inanition continues to increase from about the ninth day, when the average child weighs as much as when it was born, and even with the most careful spoon-feeding the child grows lighter and weaker until suddenly some gastro-intestinal disorder sets in and it dies of infection or on the other hand it slowly wastes away. Less often, the child has an attack of capillary bronchitis induced by the absence of nasal protection.

No class of cases requiring surgical assistance has appealed more strongly to the sentiments of operators than cases of cleft palate and harelip. These are the most distressing deformities that afflict mankind. The patient is not the only, and perhaps not the greatest, sufferer. The mother and father are distressed beyond expression. They frequently imagine all sorts of causes which they conceive might

27 (*a*)



28 (*b*)

a Curved incision according to v. Bruns. *b* Diebenbach's plastic operation

have been avoided. They are told many superstitions, among them the theory of maternal impression. Physicians themselves have attributed this arrest of development to want of meat diet on the part of the mother, errors in assimilation, and to overwork.

The parents should be assured that such conditions in the child are purely accidental and wholly beyond prescience or prevention.* They stand in the same category as other congenital malformations, such as monstrosities.

Everything should be done at once in order to pro-

*Ballantyne (Tetratogenesis: an inquiry into the causes of monstrosities; history of the theories of the past. Edinburgh, Oliver & Boyd, 1897, 8 vol., pp. 1-62) has very carefully examined the evidence upon which the theory of maternal impressions is founded, and he concludes that it is unreliable and that the alleged cases are accidental coincidences. His work, which includes an extensive bibliography, is of historical value.

tect the child from the inanition which is sure to follow spoon-feeding, and the mental suffering, both that of childhood and adult life, which isolates the patient, interrupts its education, spoils its temper, and ruins its social development. All of these dangers call for an early and complete repair of the defect.

Cleft palate was known in the earliest times. It is common among all peoples and nations. It is known to have existed among the aborigines of America. Harrison Allen (New York Medical Journal, December 23, 1893) describes the skull of an adult pre-Columbian Seminole Indian with a median fissure of the hard palate.

SCHEME OF CLEFT PALATE

I. Uranochisma, complete naso-pharyngeal fissure; (*a*) unilateral, on one side of the vomer; (*b*) bilateral, on both sides of the vomer.

II. Uranocolobom, partial naso-pharyngeal fissure; (a) posterior, fissure of the uvula and partial fissure of the hard palate; (b) anterior—harelip; (*a*) unilateral, into one nostril; (*b*) bilateral, into both nostrils.

Harelip and cleft palate are transmitted to the offspring like other accidental congenital malformations. All observers testify to the fact that it runs in the family. Some associate it with families in which rickets occur. It would not be surprising if a child with harelip or cleft palate had rickets from lack of nourishment. Lawson Tait and Truman Brophy think that this defect is more liable to occur in certain geographical localities than in others. This does not

mean, however, that it is an accident depending upon any local geologic, but rather upon an ethnic or clannish condition. Sir William Ferguson looks upon intermarriage of relatives as disposing toward this defect.

29
(*a*) The bifid or cleft uvula. Uranocolobom.) (Brophy.)

30
(*b*) The most extensive cleft palate. Complete cleft palate and double harelip. (Uranochisma bilaterale.) (Brophy.)

31
a Left-sided cleft.

32
b Double cleft.

The parents or guardian of the child should be informed how dangerous the operation is, and how necessary to the child's life and health. If the patient is an adult he should know the difficulties and chances of failure.

Operations on the mouth, especially in infants, are

attended by some difficulties which should be provided against as far as possible. The patient should not be suffering from any infectious disease. The nose and mouth of adults should be kept very clean days before the operation is begun. A suppurating tonsil should be removed or otherwise cured before an operation is begun on the palate. From a tonsilitis there has gone out an infection which has destroyed an otherwise promising uranoplastic operation. The patient should be prepared in the usual way for the anæsthetic by emptying the intestinal tract and securing a few days of rest in bed.*

The operation is safely done under chloroform narcosis, since the head can be dropped down over the end of the table enough to prevent the blood flowing into the pharynx or trachea (Rose). The head and hair of the patient should be covered with a wet sublimated or sterilized towel carefully pinned on; the face and lips well washed and a self-retaining gag put in place. The tongue should be lightly and carefully raised up with a tongue depressor or mouth-mirror. This must be cautiously used so as to not interfere with breathing. During the intervals when it is necessary to stop operating and renew the chloroform the speculum can be removed and sponges applied to the wounds to arrest the bleeding. The tongue can be controlled by a large stitch passed through it. The operation can be done in the sunlight or the operator can wear an electric head-band illuminator. The mouth is always dark.

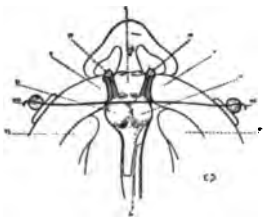
*A preliminary tracheotomy, as practiced in one case by Henry O. Marcy (Jour. Am. Med. Assn., Oct. 25, 1890, vol. xv, p. 593), cannot be tolerated as anything but an exceptional necessity.

The operation has been divided into stages:

1. The child is anæsthetized with chloroform and the head dropped back over the edge of the table. The mouth is thoroughly washed out with sponges saturated in boric acid solution or in lysol. The nasal cavity is still more carefully cleansed with smaller sponges.

2. The edges of the cleft or clefts and the vomer are denuded of their mucous membrane by a pair of small scissors curved on the flat, with the help of a sharp tenaculum or hook. Hot sponges are held over the raw surfaces to stop all bleeding.

3. With a strong, narrow knife an incision is made through the lateral wall of the palate just above the alveolus and high enough up so as to escape the matrices of the molars. This incision will enter the antrum. By sweeping the knife backward and forward a large incision is made in the soft bone through a small cut in the mucous membrane. It is carried forward far enough to secure the coaptation of the posterior part of the cleft. The same procedure is carried out on the opposite side.



33. Pressing back of the intermaxillary bone by means of a sub-periosteal incision of the vomer (III), whose two sides can thus overlap. One deep suture (VIII) passed from one edge of the lip to the other supports the two lateral sutures (IV).

4. A needle with an eye near the point and a strong handle is now thrust through the aveolus just above the palatal plate, and the eye in the point is threaded with strong silk and pulled back. Three-quarters of an inch in front of this stitch a second is

introduced in the same manner. By means of these silk threads large silver wire stitches are drawn through the perforations and securely brought together over two perforated lead plates on the outside of the alveolar processes and firmly drawn together, as shown in figure 34. If there is any difficulty in introducing either of the stitches from side to side they may be caught

..Lead button.

..Silver wire carried through bones and fixed through button. (Brophy.)

Cleft approximated. (Brophy.)

34

in the middle line through the fissure and the needle passed from the opposite side to the middle line and threaded and withdrawn. A similar stitch is necessary when the cleft is complete, inserted very close to the alæ of the nose, as shown in figure *b*, under cleft palate (Forgue and Reclus). As these silver wire stitches are brought together, the fissure in the roof of the mouth is firmly coaptated and the soft palate and the harelip fastened together with catgut or silk stitches. This portion of the operation is attended with little hemorrhage. The germs of the teeth are disturbed if the needle is inserted too low, but these defects are of little account as compared with the cleft palate. The roof of the mouth may seem dreadfully deformed and contracted, but experience has shown that the alveolus grows with the eruption of the teeth so as to compensate for the narrow palate.

The after-treatment consists in carefully cleansing the mouth after each feeding, by using pledgets of cotton saturated in borax and solution. The wire stitch can be removed without an anesthetic ten days after its insertion.

When a partial posterior cleft palate has been neglected and the infant grows to childhood or maturity, it has a nasal articulation, which interrupts its education and social development. The ridicule or unpleasant notice which this defect arouses produces a painful psychosis. The patient is unable to keep the nose and pharynx clean. Great dry scabs accumulate on the posterior wall. He suffers from repeated and severe attacks of pharyngitis and bronchitis. All of these conditions call for operative or other orthopœdic efforts. The jaw is now ossified. The teeth are in place. It is not practical to bring the sides of the upper jaw together sufficiently to secure a bony palate. Under such circumstances the best results are produced by supplying the patient with an inflated soft rubber palate filling the posterior nares. With such a device many patients are able to improve their enunciation and even learn a new language without any noticeable nasal twang. Surgical efforts directed toward the same end are not more successful even under the best circumstances, and can hardly be recommended after the child has reached the age of six years or more.

When a partial cleft palate involving the hard palate has been neglected until the patient is six years old or older, any attempt to repair the defect, though it prove an anatomic success, is almost sure

to be a physiologic failure. Such cases should be recommended to dentists, who make artificial palates with remarkable results. After unsuccessful operations have been performed, an artificial palate is not as manageable as it would have been in the uninjured mouth.

Double uvula in the adult can be easily treated by simply cocainizing the parts and cutting away the mucous membrane on the inner surfaces of the bifid uvula and then bringing them together with fine silk stitches. Great care should be taken to bring all the muscular apparatus of the uvula into proper coaptation.

35. Manner of rendering inactive the tensor palati muscle until the freshly approximated surfaces of the palate unite. (Brophy.)

George T. Carpenter* reports the following interesting case, in which the turbinated bone closed the fissure in the hard palate:

The patient, a woman twenty-two years old, had a double harelip and cleft of both hard and soft palate, which was very large. Nature had largely overcome the latter defect by hypertrophy of the inferior turbinated bodies, and in consequence, the voice, though not good, was much better than many with a very slight opening in the hard palate. But the deformity of the lip did not improve. The patient was well developed, strong, and healthy. She had always lived in the country. Owing to her mother's opposition to surgery, the lip was not operated on. She was taken under treatment July 28, 1896, at which time photo-

*Journal Am. Med. Assn., April 30, 1898.

graphs were taken and a careful examination made. Five anterior teeth were very irregular and badly decayed, the two centrals being movable on account of the loose intermaxillary bones. The cuspids were irregular, but sound. With local applications of ten per cent aqueous solution of cocaine, seven teeth were removed, one of which was a supernumerary. As soon as the gums were healed, a rubber plate, with six anterior teeth and soft rubber velum, was inserted, and on September 15th the lip was operated on. The operation was performed under ether. First the mucous membrane, with considerable tissue from the central teat-like projection, was removed. A lancet was then passed through the lip on each side and cut upward and toward the median line to the extreme upper angle of the cleft. Adhesions of the lip and gum were also freely separated by the use of the knife. Then turning the flaps down (the assistant pressing the cheeks well forward), the surfaces of the flaps were brought together. Three deep catgut stitches were taken in the under side of the lip. The margin of the wound was then neatly placed in position and secured by a few fine stitches. Cohesive strips of English moleskin were placed on each cheek, which were allowed to extend to the corners of the mouth and turned under so as to leave free the anterior ends, which had holes punched for lacing. The surgical dressing was powdered iodoform covered with ten per cent iodoform gauze. The cohesive strips were then laced tightly so as to bring the cheeks well forward and relieve the tension on the stitches. Dobell's solution was used as a mouth-wash. The lacing was

removed and the wound examined each day for a week. The fine stitches were removed on the third, and deep stitches on the sixth, day. There was union by first intention. The patient was dismissed October 12th.

C. A., a farmer's boy, nineteen years old, in good health, presented himself January, 1892, with a double harelip and a wide cleft in the soft and hard palates. The cleft bifurcated anteriorly, each bifurcation following the maxillopremaxillary sutures. The vomer was greatly developed. The lower anterior marginal thickening coalesced with the premaxillary bones, which were pushed upward and forward. These parts were covered by a dense mass of vascular connective tissue. The skin did not cover the anterior surface of the nasal septum, but projected forward, appearing like a well-developed nipple. There was an opening into each maxillary antrum. The anterior posterior diameter of the oral cavity, of which casts were taken, was found to be greater than usual. The premaxillary bones, with the incisor teeth, were much developed forward of the converging rows of the other teeth. Each half of the bifid uvula was larger than a normal uvula.

Cocaine was injected into soft palate parts on each side of the fissure, and broad lateral flaps, including the periosteum from the lateral walls, were made, brought down, and sewed together in the median line as far forward as the maxillopremaxillary sutures. Nine silver wire stitches were required to hold the margins of these flaps in apposition in the median line. The making of the floor of the nose and the roof of the mouth was thus accomplished, so that on washing

out the nasal fossæ none of the solution passed through the nasal floor into the mouth.

The patient went home in March, and on his return, nearly three months after the first operation, the parts were found to be well consolidated. By the second operation the facial deformity was corrected as follows: Cocaine was injected into each lateral half of the lip. The parts were then dissected from their attachment on each side to the maxillary bones, including the alæ of the nose. It was found, however, that the flaps could not be made to cover the premaxillary bones; nor could these bones be forced back into the narrow cleft between the maxillary bones. The premaxillary bones and that portion of the vomer in front of the gap were therefore removed with bone forceps.

The anterior margin of the septum that had been made some months before was now freshened, and the canine teeth having been extracted, a rectangular flap from each side with the periosteum was raised and made to meet in the middle line in front of the lower angle of the vomer. These flaps were held to the vomer and in apposition to each other by animal sutures. The lip flaps were now brought together in the middle line and the parts held in apposition by three steel pins, around each of which a silk ligature was drawn in the manner of a figure of 8. A gauze dressing was placed over the naso-facial zone. On the seventh day, when all the dressings were removed (the pins were removed on the fifth), the parts were found entirely united. A fortnight after the operation a dental plate was adjusted, replacing the removed incisor teeth.

MAXIMS

1. Congenital malformations are not "markings." They are accidental errors of development over which we have no control and for which the parents are in no way responsible.

2. A congenital malformation in one of the parents is often transmitted to the offspring. It is distinctly hereditary, sometimes skipping one or two generations to appear in a subsequent generation.

3. Congenital malformations should be treated by careful radical reparative operation as early in life as possible.

4. Harelip may be repaired at any time, but the best results are obtained during the first year of life.

5. Cleft palate should be repaired during the first weeks of the child's life, by an osteoplastic method; later than the second year the results are very unsatisfactory.

HYDROCEPHALUS

This condition must be looked upon rather as a symptom than as a primary disease. It appears congenitally and is then related to cephaloceles and other congenital errors in the development of the skull. Clinically hydrocephalus is usually spoken of as chronic when of congenital origin, and acute when due to meningitis of a tuberculous or syphilitic origin.

There are some forms of hydrocephalus which come on late in life, and yet present the symptoms of chronic hydrocephalus. In these cases the post-mor-

tem findings demonstrate obstruction between the cerebral and dorsal arachnoid spaces.

Hydrocephalus cannot be considered a common condition, though it is met with both in the hospital and in private practice. The congenital form is easiest recognized by the unusual development of the skull as compared with the infant's face at birth. Fortunately the death rate among these children is very high.

The etiology of hydrocephalus is still clouded in mystery. The chronic or congenital form seems to be related, in many cases at least, to hereditary syphilis. In thirteen cases Elsner (Jahresbücher für Kindersheilkunde, Vol. xliii., page 457) found manifest syphilis in three cases, or in sixteen per cent. In several other of these cases he believed the enlargement of the spleen and liver pointed to syphilitic disease. The fact that many cases are improved by mercurial inunctions and by sublimate injections is also looked upon as significant of hereditary syphilis. In the Glasgow Medical Journal for 1894, Monro describes a case of Raynaud's disease occurring in a hydrocephalic girl of less than two years. This example also points toward syphilis.

Rickets is also found accompanied by hydrocephalus, but it is still uncertain what relation exists between them.

Chronic tuberculous meningitis and acute hydrocephalus are terms which have been used interchangeably in the literature, although many cases of tuberculous meningitis present no symptoms of hydrocephalus. It seems quite certain that in a few cases, at least,

hydrocephalus, coming on in late infancy or adult life, is due to tuberculous meningitis. Henoch (Kinderkrankheiten, Berlin, 1893, page 268) describes such a case in a little girl of three years. Previously she had been sound and well, but for six months her head had grown slowly in size. At last right-sided hemiplegia appeared and convulsive cough. Her head had a circumference of fifty-four centimeters—that is, it was larger than the head of a full-grown woman. The fontanelles were open and soft. There was marked exophthalmus with somnolence. She suffered with bronchial catarrh, convulsive cough, and remittent fever during the two weeks before her death. Her temperature during this time was about 104 F., and her pulse about 160 and irregular. The post-mortem showed tuberculosis at the base of the brain and all the anatomical findings of hydrocephalus.

It is possible that other forms of infection in the cerebro-spinal canal produce hydrocephalus. Seitz (Correspondenzblatt für Schweitzer Ärzte, Vol. xxv., page 417, 1895) in a case of meningitis with high fever, vomiting, and death on the fourteenth day, found all the symptoms of hydrocephalus with infection of the meninges, due to the colon bacillus. Another case with similar clinical history, but without bacteriological examination, is recorded by Sullivan (Occidental Medical Times, October, 1900). The patient was a child sixteen months old. He was healthy at birth. Suddenly he was taken with obstinate constipation, and went into a stupor lasting several days. The temperature was only slightly elevated. The head increased in size until the ante-

rior fontanelles were extremely extended; the limbs tonically contracted, especially the legs. A diagnosis was made of intestinal toxemia with secondary meningitis. A puncture was made on the left of the anterior fontanelle and four ounces of fluid were removed. There was immediate relief of tension and the child gained motion of the extremities. The operation was followed by a sharp rise of temperature. Fibrillary contraction of the opposite side of the body ensued, but this soon passed away and marked improvement followed. Two months later Quincke puncture was performed between the third and fourth lumbar vertebræ and an ounce of fluid removed. No important result followed this operation, but improvement continued.

Many cases of hydrocephalus appear after protracted diarrhœa, after dysentery, after scarlet fever, after typhoid fever, and after other exhausting infectious diseases. It is possible that in these cases the hydrocephalus is due to infection, with the colon bacillus as a sort of secondary mixed infection.

Traumatism is apparently the cause of hydrocephalus in a few cases. Faucett (Transactions of the London Pathological Society, Vol. 48, page 6) describes a case occurring in a boy who fell from a ladder and remained unconscious a few minutes. Rapidly appearing hydrocephalus led to the exploration of both cerebellar lobes. The boy died, and at the autopsy the aqueduct of Sylvius was found obliterated. Faucett found two similar cases in the records of Guy's Hospital, and Pye-Smith (Transactions of the

Pathological Society, Vol. 27, page 27) describes another similar case.

In a few cases hydrocephalus seems to result from tumor of the brain. Monro (Transactions of the Pathological Society, Vol. 35, page 17) describes such a case. A child born apparently healthy soon had convulsions, with bulging of the fontanelles. These symptoms continued for eight months, when death occurred. The findings were those of hydrocephalus, apparently due to several cysts in the middle lobe of the cerebrum. William Gordon (London Lancet, January 9, 1897) believes that adult internal hydrocephalus, when not due to acute meningitis, is due to subtentorial tumor, producing hydrocephalus either by compressing the veins of Galen, or by obstructing the outlet of the outer ventricles, or by acting in both of these ways.

O'Carroll (Dublin Journal of Medical Sciences, October 4, 1894) describes two cases of hydrocephalus with complete absence of communication between the fourth ventricle and subarachnoid space. The ventricle in the first case was closed behind by a dense fibroid membrane between three and four millimeters thick. In the second case it was closed by firm adhesion. Stiles and Bruce (Scottish Medical and Surgical Journal, March, 1898) observed that the most frequent causes of obstruction in chronic hydrocephalus are simple fibrous closure of the foramen of Magendie, adhesion of the surfaces of the tonsils of the cerebellum to each other and to the margin of the fourth ventricle, and the presence of cysts between the

arachnoid and pia, at the posterior inferior aspect of the cerebellum.

All of these etiological factors leave the bulk of cases of congenital hydrocephalus unprovided for. Therefore Czerny (Centralblatt für allgemeine Pathologie, Vol. 10, 1899) was led to investigate the condition resulting from the injection of methylblue and other pigments into the cerebro-spinal canal of rats. He found that the medulla of the adrenal glands was first and most prominently stained, and he concluded that these organs furnished the natural outlet to the lymph from these two large cavities. He also found that in cases of congenital hydrocephalus the medullary portion of the adrenals was in every case absent. It seems remarkable that this fact should have been so long overlooked, but it may be due to the normal macroscopic appearance of the glands in spite of the absence of the medulla.

It will be seen from this rehearsal that there are two distinct causes to which hydrocephalus may be assigned. In the first instance it is due to one of various forms of infection. In the second it is the result of obstruction or stenosis of the natural outlets of the cerebro-spinal canal. No one has satisfactorily explained the origin, function, course, and fate of the cerebro-spinal fluid. Were does it come from? what is it for? how long does it remain in the canal? what motions does it have? and where does it go? are questions demanding immediate answers. Until these questions are answered we are in the dark in regard to treatment.

The course of acute hydrocephalus is dependent

upon the character of the disease of which it is a symptom. It is usually measured by weeks, and in tuberculous meningitis by months. In a small proportion of cases a recovery follows which is not dependent in any way upon treatment. The few cases of chronic or congenital hydrocephalus which are due to syphilis make slow recoveries under anti-syphilitic treatment. When untreated the course of congenital hydrocephalus is measured by years. There is no tendency on the part of chronic hydrocephalus to recovery. Most patients with hydrocephalus are weak-minded, but a few show remarkable cerebration in limited directions. Wyss has studied the course and fate of forty-one congenital hydrocephalic children in Zürich. Thirty-one of these died before they were three years old. Ten lived beyond three, but less than twenty-one years. Seven had sufficient intelligence to receive some sort of education. Hohl finds that a larger proportion of hydrocephalics require artificial delivery, and that a great number are dead at birth.

The diagnosis of advanced cases of hydrocephalus is easy enough. The cranial contents is increased from one to ten or more times its normal. It is even translucent to transmitted light, and the body of the child seems to be but an appendage to the head. Such children are frequently exhibited for money by their unfortunate parents. In beginning cases, or in cases of internal hydrocephalus, the diagnosis is not so easy. Attention is called to the condition of the head by the protruding fontanelles, or by the weakness or backwardness of the child. Increased intracranial pressure may be recognized by the slow pulse,

slow respiration, and dilated pupil, or choked disc. These cases are distinguished from rickets by the relative proportions of the skull and face, though it must be remembered that most cases of hydrocephalus become rickety in the course of time. The examination of the cerebro-spinal fluid obtained by cranial or by spinal puncture is of the utmost importance in cases of acute hydrocephalus. By this means the character of the infection can frequently be recognized, and in a few instances a guide to the location of the disease can be secured. If the cerebral fluid has a different specific gravity and contains elements different from those in the spinal fluid, then the obstruction may be sought at the base. If the fluid contains the colon bacillus, or if its injection into the peritoneal cavity of rabbits produces tuberculous disease, the pathological diagnosis is easy. Unfortunately the physical and chemical conditions existing in the healthy and diseased cerebro-spinal fluid are yet insufficiently studied to make them of great diagnostic value.

The treatment of hydrocephalus must necessarily be determined by the etiology, the course, and the prognosis. If the disease is believed to be due to hereditary syphilis, anti-syphilitic treatment must be used. Heller (Deutsche med. Wochenschrift, January, 1892) gave twenty grams of the iodide of potash in minute doses, three times daily, to a case of chronic hydrocephalus. Under this treatment the child's head, which at seven months was enormous, with open anterior fontanelles as wide as a man's hand, was reduced at the end of a year to the normal size, and the child appeared perfectly healthy. The diagnosis

of syphilis in this case was still further confirmed by the appearance of Hutchinson's teeth, interstitial keratitis, and periostal gumma when the child was seven and a half years old.

If the disease is due, as Czerny believes, to obstruction of the natural outlet of the cerebro-spinal canal into the adrenal glands, then an artificial outlet must be made. This has been repeatedly done with partial success by raising a flap of scalp and introducing a short silver canula with a broad flange through the skull at the lower part of the flap, and leaving it there to drain the arachnoid space into the subcutaneous lymph spaces of the head. The flap is replaced, the scalp becomes edematous, the hydrocephalus gradually disappears, but in most cases the canula has become obstructed, and repeated operations made necessary. This procedure has also been attended by a high mortality. On this account drainage of the spinal canal by a larger canula into the open peritoneal cavity promises better results. The abdomen is opened, a vertebra is pierced by a rather large silver trochar and canula until the cerebro-spinal fluid is seen to flow freely. The abdomen is then closed with the canula in place.

LITERATURE OF HYDROCEPHALUS

Sutherland and Cheyne. The Treatment of Hydrocephalus by Intracranial Drainage. British Medical Journal, 1898, Vol. 2, page 1155.

Raczyanski. Lumbar Puncture in Hydrocephalus. Wiener klinische Rundschau, February, 1898.

Bruce and Stiles. Treatment of Hydrocephalus. Scottish Medical and Surgical Journal, March, 1898.

[illegible]

[illegible] CONGENITAL DEFECTS

[illegible] almost the opposite [illegible] It appears to be a congenital [illegible] accompanied by early ossification [illegible] and it has been thought desirable [illegible] perform such operations as would [illegible] tendency in sutures and fontanelles. [illegible] the cranial contents more room [illegible] a chance to grow have met with [illegible] The usual operation consists in [illegible] from the parietal and occipital bones, [illegible] from the middle of the forehead on each side [illegible] to the lateral sinuses. For some unknown [illegible] results of these operations have been [illegible] by great fatality. Dana (American Journal Medical Sciences, January, 1896, page 24) reports

PLATE II

A dermoid tumor of the nose which was recognized at birth. It grew with the growth of the child, till at the age of 14 it presented the above appearance. Successful removal by F. Bramann. Langenbeck's Archiv., Bd. 40.

twenty-two deaths in seventy operations, and three deaths in twelve operations in his own practice.

There are a number of congenital tumors of the face. The dermoids appear in the upper nasal cavity, in the parotid gland, and occasionally in the orbit. They show themselves in the direction of the least resistance and may be found in the mouth, in the antrum of Highmore, and at the root of the tongue.

Angiomas in the neighborhood of the embryonal fissures about the face are most common and dangerous congenital tumors. The child is born with only a little raised, compressible, red spot in front of the ear. It is covered by an excessively thin skin, which appears almost white under pressure. During the first few months of life it grows with great rapidity, and similar enlargements of capillaries and blood vessels are found an inch or more away from the primary focus. If the tumor is left to itself it spreads with great rapidity and the child dies of metastatic sarcomas. The diagnosis is easy. The tumor is an angioma, and penetrates the subcutaneous parts and invades the skin. It is recognized at the corner of the eye, near the alæ of the nose, at the corner of the mouth, or just in front of the ear over the parotid gland. Rarely they are seen in the middle line of the forehead or on the vault as far back as the occiput, and rarest of all in the region of the mastoid. The treatment consists in early, bloodless removal by the use of harelip pins and constrictor in some such manner as that described for meningocele.

There is a very peculiar congenital lymphangioma

which appears in the face at birth as a mere thickening, most generally in the region of the mouth. It is analogous to the angiomas described above, and maintains much the same course.

36. Congenital hypertrophy of the right cheek and upper lip in a three-year-old child. (Kirmisson.)

Hypertrophic conditions show themselves in the face the same as in the extremities. A single portion of the face, one of the upper or one of the lower maxillæ is larger at birth than its fellow, and grows with great rapidity. Cases are reported illustrating this peculiar congenital hypertrophy in the nose, the cheek, the lip, the cheek wall as well as the bones of the face. The diagnosis is not always easy, and when it has been made, treatment is exceedingly unsatisfactory. At the best some surgical operation or the use of destructive agents, such as chemical escharotics and the hot iron, leave the face in almost as bad a condition as the original deformity.

Congenital malformations of the salivary glands are less numerous than interesting. The submaxillary is sometimes wanting and sometimes displaced. The ducts are frequently misplaced, even opening in the neck. The parotid is the site of congenital teratomas.

LITERATURE

Ahlfeld. Die Missbildungen des Menschen. 1882.

Witzel. Ueber die angeborene Spaltung der obereren Gesichthälfte, Langenbeck's Archiv, Bd. 27.

Nasse, D. Zwei Fälle von angeborener medianer Spaltung der Nase. Arch. f. klin. Chir. Bd. 49, S. 767.

Kirmisson, E. Lehrbuch der chirurgischen Krankheiten angebornen Ursprungs.

Fillebrswen, Thos. Report of an operation for cleft palate, Journal of Medical Science, Portland, vol, 4, p. 127. March, 1898.

Forbes, W. S. Case of cleft palate, hard and soft and double harelip; boy 19 years old. Medical News, September 2, 1893.

Vanderveer, A. Article of cleft palate: technique of operation. Handbook of Medical Science, N. Y., 1901, p. 179.

Turner. Journal of Anatomy and Physiology. Vol. 4, 1869, p. 147.

Guber. Virchow's Archiv. Bd. 102. 1885. S. 9.

Ballantyne, J. W. Trans. Edin. Obst. Soc. xv, 109, 1890.
Diseases of the fetus, ii, 204, 1895.
Archiv. Pediatrics, ix, 275, 1892.*
The antenatal and intranatal factors in neonatal pathology, etc. Journal American Medical Association, November 18, 1899.*

Ballantyne, J. W. and Thos. J. American Journal of Obstetrics, xxxv, 161, 1897.

Ballantyne, J. W. Archives of Pediatrics, x, 848, 1893.*

Bond, H. A. Virginia Medical Semi-Monthly, xxi, 1074, 1895.

Fenger, Ch. Basal hernias of the Brain. American Journal of Medical Sciences, January, 1895.*

Fenn, E. Large congenital meningocele. British Medical Journal, London, 1893, ii, 1211.

Féré. Revue Mensuelle de Med. et de Chir., iv, 112, 1880.

Kader, B. Caput Obstipum Musculare. Przeglad Chirurgiczny, iv, 93, 1898.

Keen, W. W. Four congenital tumors of the head and spine, etc.
International clinic, October, 1891.*

Kirmisson, E. Lehrbuch der chirurgischen Krankheiten angeborenen Ursprungs. Stuttgart, 1899.

Stieda, H. Die Anomalien der menschlichen Hinterhauptsschuppe. Anatomische Hefte. Wiesbaden, 1892.

Larger. De l'exencéphale encephalocéle congenitale. Arch. gen. d. med., 1877.

Mackie, W. A case of encephalocéle, removal, hydrocephalus, death. British Medical Journal, London, 1894, i, 510.

Marks, H. Hernia cerebri and tuberculosis. St. Louis Cour. Med., 1894, xi, 109, 1 pl.

Meriwether, F. I. A large meningocele. American Journal of Obstetrics, New York, 1894, xxx, 226-9.*

McCurdy, S. L. Detail in cleft palate operation. American Medical Association, October 28, 1899.*

Sloan, M. G. Meningocele with case. Journal of American Medical Association, Chicago, 1893, xxi, 892.*

von Bergmann, E. Die chirurgische Behandlung von Hirnkrankheiten. Berlin, 1899.

Spencer, H. R. Trans. Obstetric Society, London, xxxiii, 305, 1891.

Spring. Sur les hernies du cerveau, Bruxelles, 1853.

Stein, H. Ueber Spina Bifida und Cephalocele, Berlin, 1894.*

Thomas, H. M. Journal of Nervous and Mental Diseases, xxv, 571, 1898.

Thompson, J. Congenital obliteration of the bile duct, Edinburg, 1892.

Zaaijer, T. Die Persistenz der Synchondrosis condylo-squamosa, etc. Beiträge zur Anatomie und Entwicklungsgeschichte, 1894.

Hildebrand. Zur Operation Behandlung der Hirn-und Rückenmarksbrüche. Deut. Zeit. f. Chir. Bd. 28, p. 438.

Pfaundler, M. Lumbalpunctionen an Kindern. Leipzig, 1899.

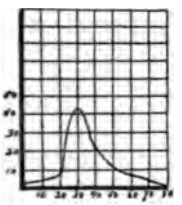
CHAPTER III

INJURIES OF THE HEAD AND FACE

General considerations and statistics; scalp wounds; hematoma of the scalp; pneumatocele capitis; injuries of the face; fracture of the zygoma.

INJURIES OF THE HEAD

Injuries of the head may conveniently be divided for study into injuries of the scalp, injuries of the soft parts of the face, injuries of the bones of the face, injuries (fractures for the most part) of the skull, injuries of the cranial contents. In one series of 1,187 consecutive surgical cases admitted to Cook County Hospital, there were 233 injuries or diseases of the head, of which 105 were scalp wounds. The predominance of patients between the ages of twenty and forty in hospital practice makes all statistics from these institutions misleading unless this fact is kept in mind. The accompanying curve shows the distribution of 3,823 patients in Cook County Hospital, distributed according to the various decades of life, and without regard to the anatomical part of the body concerned.



37. Curve showing age of admission of 3,823 patients treated in Cook County Hospital during six months; 2,814 of these were males, 1,009 were females. This is probably about the curve for patients in all general hospitals. In older communities the ages are perhaps distributed in the decades beyond the third in a larger proportion.

In studying the frequency of any form of disease, as large a number of cases as possible should be taken. They should be carefully considered, with special reference to their reliability, and all modifying influences should be carefully measured. It would be worth while to read Pearson* and the various authors on vital statistics, in order to get some idea of the importance and complexity of the subject.

After collecting any considerable number of cases, a graphic representation should be made, exhibiting the chief points to be learned from them. A separate curve may be required for each of several countries or for the same country at different times. In particular conditions, as for example, in injuries of the head, it may be desirable to study those occurring in railway injuries and to compare them.

SCALP WOUNDS

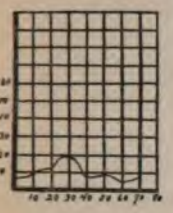
Anatomy of the scalp; tendency of infection; blood supply; communicating veins; wounds of scalp before birth; at birth; after birth; incised, lacerated, and punctured scalp wounds; wounds by indirect injury; small and punctured scalp wounds more dangerous than large or incised wounds.

SCALP WOUNDS

The scalp is a tough and cushion-like covering of the skull made of modified skin. The larger portion of the scalp is covered with hair. The scalp varies in thickness from .6 cm. over the temples to a centimeter or more in thickness over the occiput. The

* Pearson, Carl. The Chances of Death. London, 1897.

scalp is directly in contact with the skull in only a few places, elsewhere the skull is covered with a thick layer of muscle, as over the lower portion of the parietal bones, or by a thin muscle, as over the forehead. These muscles are covered by a dense fibrous tissue, adherent to the skin, known as the aponeurosis. The whole structure covering the skull may be placed in five layers: the skin, the subcutaneous fatty tissue, the muscles and their covering of aponeurosis, the subaponeurotic connecting tissue, the pericranium. The skin is so thick and glandular that it is difficult if not impossible to make it clean, and when infected it is so dense that it does not show edema and redness as skin does elsewhere on the body. When the outlets of the sebaceous glands are injured by trauma or disease, there often results a retention tumor or cyst. Infection between any two layers covering the skull tends to burrow onward between these layers, rather than raise them up and penetrate them. The firmness of the scalp is such that wounds of the scalp do not gape open as wounds of the skin elsewhere on the body do, except when the scalp is cut transversely through the occipito-frontalis muscle. Then contraction of this muscle pulls the wound open. The mobility of the scalp is greater in the young than in the aged, and is least on bald heads.



38. Curve showing ages at which scalp wounds appeared in the Westminster Hospital 1885-1897, and the London Hospital in 1887.

The scalp is very vascular, and therefore bleeds freely, but rarely sloughs, even though greatly lacer-

ated. The complete arrest of hemorrage from the scalp is frequently quite difficult. The blood supply of the scalp is derived from four arteries on each side of the head, the supraorbital, the temporal, the posterior auricular, and the occipital, with some anastomoses through the sutures of the skull with the intracranial blood supply.

The veins of the scalp communicate with the veins and sinuses within the skull by the mastoid foramina, by the parietal foramina, by the posterior condyloid foramina, by the foramina ovales, and by the lacerated foramina. Through any of these veins, infection may advance from one side of the skull to the other, by means of advancing infected thrombosis.

Scalp wounds are sometimes produced before birth in attempts at abortion or infanticide, and rarely by wounds inflicted through the mother's abdomen and uterus; during birth by meddlesome or unskilled midwifery, or in the course of necessary obstetric operations. One of the most common forms of these early scalp wounds is produced by midwives and physicians mistaking a caput succedaneum for the distended bag of waters, and cutting it with knife or scissors. The infant's scalp has, in the process of birth, been torn, and on account of its looseness completely turned back over the face and neck, and the child has been put in jeopardy of its life from suffocation.

Scalp wounds are said to be incised when they are clean cut, lacerated when they are irregularly torn, and punctured when they are made with a small pointed instrument without cutting edges. If clean, wounds of the scalp in any of these forms, even when

VIA GIL

greatly contused, heal with equal readiness. A perfectly incised scalp wound is often made by a fall upon a smooth, hard body, or by a blow with a round smooth stone or other object.

Scalp wounds are usually, if not always, infected wounds. The glands of the scalp itself are full of all sorts of infectious material, and the instrument making the wound usually carries pieces of the head-gear and the hair into the bottom of the wound, where, with the infection they carry, they are held by the returning scalp. Under unusual circumstances a scalp wound may be uninfected. The incised wounds are most apt to be clean, the lacerated wounds are most apt to be dirty. The punctured wounds are usually infected, and they result most seriously if let alone. When the puncturing instrument enters the scalp, it carries infection, and when it comes out, this infection is left in the deepest part of the wound, being wiped off the instrument. The most favorable form of scalp wound under expectant treatment is the large incised wound.

Small scalp wounds are cleansed with more difficulty than large ones. Only fresh scalp wounds can be successfully sterilized. Old scalp wounds are always infected.

Scalp wounds are said to be complicated when they are attended by injuries of other parts in the same individual. Thus a scalp wound may be accompanied by fracture of the skull, either of the base or of the vault, or by fracture of the femur, or of the clavicle. In many cases the scalp wound, though the more obvious, is of relatively little importance. Uncompli-

cated scalp wounds are often spoken of as simple scalp wounds.

The hemorrhage from scalp wounds is sometimes very great. Many cases of fatal hemorrhage have occurred from the temporal and occipital arteries. Only rarely is it necessary to ligate the blood vessels of the scalp. It is usually enough to hold them in the jaws of an artery forceps for a minute or two. Bleeding from the edges of the flap, called capillary oozing, can be stopped by heat or by pinching the whole edge of the scalp in a T-shaped forceps. When for any reason scalp wounds are made by the surgeon in the course of an operation, the bleeding can be prevented by the use of a double row of lock-stitch sutures about the circumference of the flap, and then cutting between the two rows of stitches. A single row of these stitches may be used, cutting just inside it because the flap itself will not bleed after it is turned sharply back on its pedicle.

Example showing course of scalp wound without treatment; scalp wound with fracture of the skull and concussion of the brain in pre-antiseptic times; symptoms of sepsis; ultimate recovery.

F, laborer, aged 34, strong constitution, while engaged upon a cart loaded with hay, tightening the rope to press down the hay, was suddenly lifted up and then thrown to the ground. For a few moments he was unconscious, but on removal to the hospital of Gros Caillon, he was pale, drowsy, and in a general paralytic state. The right cheek was swollen, the nose crushed in, a transverse wound above the right

eyebrow, a radiated fracture of the frontal bone, and several wounds on the extremities. At times he was out of his senses, and trembled in every limb. He had a very slow pulse, and answered very few questions. The body was warmed and hot compresses applied after the head had been shaved. Symptoms of inflammation were noticed in the wounds on the next day, so that the head wound was dilated and the fracture exposed. The fracture divided the external wall of the right frontal sinus. The trephine seemed not to be necessary, as no bony fragments were sunk inwards. On the eighth day the stupor left the patient, and he was able to ask for anything that he needed. Several small abscesses formed on the eyelids and at the root of the nose: these were opened. On the thirteenth day, when everything seemed favorable, symptoms of adynamia made their appearance, accompanied by stupor and gastric derangement. Emetics were freely given, and the patient perspired and remained quiet. He remained in a state of somnolency for days, but the wounds healed, and finally the patient recovered his senses and left the hospital. (Larrey, Observations on Wounds, etc., Philadelphia, 1832.)

Many cases similar to this case, presenting all sorts of infection, can be found in the literature of the pre-antiseptic period. It is well to read the older authors in order to learn what was the ordinary course in surgical conditions before the cause of inflammation had been discovered.

The diagnosis of a scalp wound is usually obvious, though a punctured scalp wound or an old scabbed-over scalp wound may be overlooked in an uncon-

scious or delirious patient. Drunkenness is so often considered a sufficient cause of delirium that no examination is made of other possible sources of illusions and inco-ordination.

The great difficulty which is met with in diagnosis of a scalp wound is to exclude all other possible injuries. Many scalp wounds are accompanied by fractures of the skull, and many by injuries of the brain. The diagnosis must be exclusive. In order to make the exclusive diagnosis, the head must be shaved and the wound enlarged if necessary, and every care taken to provide against infection during this examination. A fracture of the skull, or hemorrhage within the skull, demands closest attention.

Epileptics frequently fall, and striking on hard objects, inflict scalp wounds that seem to be incised wounds. In such cases many old scars may be found, and the observer may be able to predict an early return of consciousness in the apparently severely injured patient.

Scalp wounds on drunkards often initiate an attack of delirium tremens, and there is danger that the beginner will overlook intracranial infection when symptoms of delirium are attributed to alcoholism.

In treating scalp wounds a large area of the surrounding scalp should be shaved (two or three inches from the edge of the wound) and the whole scalp and the open wound carefully sterilized. The rest of the head should be covered with wet sublimated or dry sterilized towels. The edges should be trimmed with sharp curved scissors. All forms of scalp wounds should be made into incised wounds of sufficient size

to permit careful and satisfactory exploration and examination with the index finger. Any other probe is dangerous. Fractures of the skull and foreign bodies must be looked for. The aponeurosis and muscle may be wounded quite a distance from the scalp wound, and quite out of sight. The edges of the scalp wound are not easily shaved. It is often necessary to trim them off with a knife or scissors in order to sterilize the wound. The scalp does not retract much when wounded, but the stitches should be put in quite a distance, 2 cm. or more, from the edges of the wound, and should be numerous enough to secure perfect coaptation. Drainage must be used when the wound cannot be made clean, or when the hemorrhage cannot be completely stopped.

There have remained in the minds of physicians many traditions respecting the dangers of sewing up scalp wounds. In pre-antiseptic times erysipelas was common after scalp wounds, and especially after those that were sewed up. Now we know why these complications followed. The wounds were not clean. On account of these accidents, all sorts of methods were used to coaptate the wounds without stitches. The hairs were tied together, adhesive straps were used, and other means that allowed some drainage. All such methods are to be dispensed with. The scalp is not different from other skin and must be subject to the same treatment.

In old, and therefore suppurating, scalp wounds the sharp spoon must be used to scrape off the granulations, and then all parts can be repeatedly washed with antiseptics. Mechanical removal of the infection

should here be the object in the surgeon's mind. When this object is accomplished, the old scalp wound can be treated as a fresh wound. It is safer, however, in such cases to use drainage, temporarily at least.

Occasionally there are cases where a large portion of the scalp is removed, in mass, by machinery. When these pieces of skin can be found and made clean, they can occasionally be replaced and made to grow. In every case such an attempt is to be considered. When the detached scalp is lost or so injured that it dies, the skull can be covered by transplanting bridges of the adjoining scalp over the denuded portions of the skull. In a few cases the whole scalp has been removed from the nape of the neck to the eyebrows, and in these cases it is necessary to transplant skin from other parts of the body. Dr. F. C. Schaeffer, of the Northwestern University Medical College, has reported such a case.

SCHAEFFER, FREDERICK C. *Skin-grafting upon the cranium; complete removal of scalp; recovery.* (*Jour. Am. Med. Assn.*, *Feb. 11, 1893.*)

The patient was a woman 24 years old, whose hair was caught in a revolving shaft in a laundry. The shaft was five centimeters below a heavy beam, and about two and a half meters above the floor. It was making 250 revolutions a minute when the girl's hair blew against it and she was drawn suddenly against the beam and shaft and then fell to the floor without her scalp. She was able to walk immediately up a flight of stairs. The entire skull was laid bare from the margin of the eyebrows to the nape of the neck.

The nasal bones were uncovered and broken, the skin of the eyelids was removed to within three millimeters of the eyelashes. The left ear was entirely removed with the scalp. Every vessel and nerve supplying the scalp was torn off. The exposed surface measured 45 centimeters from before backward and 39 centimeters over the bregma. The hemorrhage was profuse, but easily controlled. The scalp was removed from the shaft and carefully sterilized and applied to the skull, but it was necessary to remove the necrotic mass after a few days. Skin-grafting was begun six weeks after the accident and was continued for nearly two years.

39

40

The accompanying pictures show the extent of the denudation, and the result of the skin-grafting.

Schaeffer has collected six other cases of loss of scalp in which similar results have been obtained.

From this consideration of wounds of the scalp, when taken in connection with a study of wounds elsewhere, we may draw the following conclusions in relation to the duty of the surgeon:

1. Make an absolute and *exclusive* diagnosis. In each case see to it that there is nothing the matter with the patient except the scalp wound. Look out for fractures of the skull especially.
2. Apply the several rules for wound treatment, viz:
   A. *Make and keep the wound clean.*
   B. *Arrest all hemorrhage.*
   C. *Secure perfect coaptation.*
3. When these rules cannot be carried out to a successful issue
   D. *Institute adequate drainage.*

All drainage should, if possible, be through and through drainage.

ADAGES

1. Shave three inches about every scalp wound.
2. Make every scalp wound into a large incised scalp wound so that it may be explored with the finger.
3. Use no probe except the index-finger.
4. Trim with the scissors the edges of a scalp wound; the razor and the brush are not effective.
5. Scrape out an old scalp wound with a sharp spoon as a part of the mechanical removal of infection.
6. Sew up clean and bloodless scalp wounds without drainage, inserting the stitches half an inch or more from the edges of the wound, and tying on one side.
7. Remove the stitches at the end of forty-eight hours, being careful to cut the stitches near the skin so that none of the exposed and infected silk will be drawn through the scalp.

HEMATOMA OF THE SCALP

Contusion of the scalp without an open wound and without any injury to the skull or its contents is apt to occur from a fall or blow at a tangent to the skull. The blood vessels of the scalp are thus injured, and a great effusion of blood appears under the percranium, which by pressure may interfere with the nutrition of the underlying skull. After the blood has been effused some days, and it is removed by incision or aspiration, the overlying scalp is so much stretched and thinned that the skull feels as if depressed sharply at the margin of the space recently filled by the hematoma. When these hematomas are connected with larger blood vessels, arteries, or emissary veins, they pulsate and show a tendency to undermine a larger and larger area of scalp. As a rule they require no treatment except compression and protection. If in any way infection should take place, free drainage must be established. There is no reason why the effusion should not be removed at once, but if this is undertaken, the surgeon must be ready for any operation on the skull or blood vessels.

A child eight years old fell from a porch, striking on the left side of the head over the parietal bone. There was no wound of the skin, but the child was unconscious (concussion?) for a half-hour. On the following day there was a considerable tumor over the injured part. In feeling this tumor the impression was given of an elliptical depressed fracture of the skull covered by some fluid. The finger passed off the edge into a deep, smooth lake. This impres-

sion was so strong that I seriously contemplated recommending operation. The perfect mental condition of the patient restrained me, and after a few days' use of compression and cold applications, the diagnosis became easy. It took several weeks of treatment to restore the scalp to its place on the skull. The child was seen by me several years later, and the location of the hematoma was easily recognized by a sort of depression covered by a thinner growth of hair than that on the opposite side of the head.

The so-called cephalhematoma of the new-born belongs rather to the obstetrician than to the surgeon, but it is of great theoretical importance to both. This injury comes from impact with the mother's pelvis, and is met with, according to many observers, in one out of every one hundred and fifty or three hundred births. On account of the frequency of this presentation, the hematoma is found over the parietal region in more than nine-tenths of all cases, and on the right side of the head twice as often as on the left. The tumor is rarely found over the forehead, but a little oftener over the occiput. These tumors seem to lie in two separate strata of the scalp, in the one case just under the aponeurosis, and in the other under the periosteum. The latter is sometimes associated with fracture of the skull and a similar hematoma between it and the dura. This hematoma is associated, and in some cases blended, with caput succedaneum. When the hemorrhage is subpericranial it rarely extends beyond the sutures between two bones, because the pericranium is freely attached to the sutures.

In case of extra dural hemorrhage occuring at birth, it is likely that operation would be useless, as in the following case:

KEOWN, T. W. *Cephalhematoma with cerebral hemorrhage (Medical News 1895, p. 451); difficult delivery; convulsion and symptoms of anemia 24 hours after birth; death; autopsy; extra dural hemorrhage from (?) artery on both sides of the brain.*

M. M., a strong and vigorous primipara, aged 33 years, of Irish parentage and medium height, and in good robust condition, was delivered of a female baby, on July 13th, after a labor of twenty hours. The pains were normal in general, but owing to a rigid perineum they became very forcible towards the end of the second stage. The child weighed six and one-half pounds, and appeared in fairly good condition. Its circulation and respiration were normal. The caput succedaneum was not noticeably larger than would naturally have been expected in such a case. On the second day the child attempted to nurse, and seemed to be as much alive as any other child of the same age. On the night of July 14th it became restless, and cried almost continuously, in a low, feeble, whining manner. On the morning of July 15th it was much weaker, seemed to be wasting away, and was decidedly anemic looking. The mother related that the baby had had fits, one of which occurred in my presence. The eyes of the child were rolled upward, and the arms and limbs were flexed and twitched spasmodically, giving in general the impression of a hemorrhage over both hemispheres of the brain.

Examination of the head showed a soft, fluctuating tumor over the right parietal bone extending to, but limited by, the sutures surrounding that bone. The child vomited frequently, had several spasms, no longer attempted to nurse, and died on the third day.

Dr. Wilmer Brinton was called to see the child some hours before death, and pronounced the case one of cephalhematoma with general cerebral hemorrhage. The anemia was then so pronounced that a very unfavorable prognosis was given. An autopsy was held on July 16th, by Dr. Richardson, from whose report I have made the following extracts: On the right side of the head was a soft, bluish swelling, extending from a point 4.5 cm. from the external angular process upward and backward to the sagittal and lambdoid sutures and to the anterior fontanelle, covering practically the whole parietal bone on the right. On dividing the scalp there was an effusion of dark blood exposed. Over the parietal bone on the right side the pericranium was distended with blood, which spurted out on puncture. The extravasation of blood covered an area of 7.5x7 cm. On removal of the bone the dura mater was found firmly attached to the base and sides of the skull. Under the dura mater a large extravasation of blood was found, forming a clot that extended over both hemispheres from the fissure of Rolando posteriorly to the occiput and into the transverse fissure. On both sides of the hemispheres in the parieto-occipital fissures were two spots about the size of the end of the index-finger in which softening and degeneration had occurred (?). These looked very much like abscesses, but Dr. Richardson was unable

to say positively. The lungs were inflated and floated easily in water. The foramen ovale was still open.

PNEUMATOCELE CAPITIS OR EMPHYSEMA OF THE SCALP

Pneumatocele capitis is a tumor which results from the injection of the tissues with air. The air is usually pumped into the tissues during expiration or by the act of sneezing, and enters the connective tissue spaces by means of compound fractures in connection with the nasal or pharyngeal space. Andral noticed such a case, in which through fracture in the frontal sinus an emphysema of the scalp resulted which spread over the whole body. The same thing he also observed in fracture of the mastoid process.

Pneumatocele also occurs with otitis media. In these instances it is usually the result of disintegration of the wall of the middle ear resulting in a condition similar to fracture. The air in such cases is forced by coughing or by expiration through the eustachian tube into the middle ear and into the lymph spaces about the meatus.

The treatment of pneumatocele consists in free incision of the inflated tissue, and the obliteration of the atrium of injection. The fractured or opened areas should be covered with a tampon of iodoform gauze, and in case of suppurating ear disease the middle ear should be approached in the usual manner and carefully cleaned out.

This form of emphysema should not be confounded with infection of the scalp with gas-forming bacilli. (Vid. Acute emphysematous gangrene.)

INJURIES OF THE FACE

Injuries during birth; contusions of the face; lacerated wounds of the face; incised wounds of the face; injury of the facial nerve; of the fifth nerve; of the eyelid; amputation and repair of the tip of the nose and pieces of the ear; injury of Stenson's duct and the parotid gland; gunshot wounds of the face; burns of the face; simple fractures of the lower jaw; simple fractures of the malar and superior maxillary bones; fracture of the bones of the nose; fracture of the zygoma.

During birth the face is sometimes contused, torn, or otherwise injured in passage through the pelvic strait, or by the traction of the forceps. In this way the lid and scalp have been torn off, and the cheek walls so crushed as to die and slough off.

41. The nerves of the face and of the side of the head. (From Meckel.)

The face is frequently injured after birth by falls and blows producing great extravasation and edema. The rich circulation of the face and its abundant lymph supply leads to the appearance of tremendous bumps and swellings in an inconceivably short time after the injury. Actual hematomas appear, especially about the eyes and about the cheek wall. The lips and the cheeks are not only bruised from without by blows and falls, but they are terribly torn and cut by pressure of the teeth from within. These tears swell excessively, and are quickly covered with a black

eschar. Sometimes the injury is such as to produce a large hematoma in the cheek, which becomes infected and results in an abscess leaving a stellate scar and great deformity. Foreign bodies, slivers of wood, bits of stone and glass frequently lodge in the cheek and face, and become the center from which chronic infection goes out.

The worst injuries of the face are due to dog bites, to explosions, and to injuries with heavy machinery. The whole cheek wall, the nose, the eyelids, and even the globes of the eye itself are carried away, leaving a terrible wound which must be closed by transplantation or skin-grafting.

The face has a wonderful power of repair. The blood supply is so great that large flaps of contused tissue, when properly sterilized, grow in place with less gangrene than would be expected elsewhere. Contused wounds and lacerated wounds bleed less than incised wounds, but there is usually a large amount of hemorrhage from wounds of the face. The blood can usually be stopped by hot applications, and possibly ligature of branches of the facial and temporal arteries. After thorough cleansing of the wound and removing blood clots the edges can be brought together with stitches put in at a great distance from the lacerated tissues. Drainage must be used during the first twenty-four or forty-eight hours, and the interior wounds opening into the mouth or nose must be allowed to heal under an antiseptic dressing by the processes of granulation. Such defects as are left can sometimes be best treated by excision of ugly scars, and transplantation of skin from adjoining parts.

Incised wounds of the face are more dangerous on account of hemorrhage, but in other respects they are very simple and easily treated. The blood can be stopped by ligature of the larger arteries and compression of the smaller ones, and the oozing can be arrested by the application of hot sponges. It is almost unnecessary to say that no stitches should be introduced until all the blood is stopped and the wound is perfectly clean and dry. The greatest care must be taken in the treatment of stabs and punctured wounds by first making them into large incised wounds, stopping the blood and making them perfectly aseptic. Wounds of the face must be so perfectly coaptated as to bring every part together with the part from which it was severed in order to restore the expression of the face. This is especially the case when the facial nerve has been cut in the region of the parotid. The larger branches of the nerve must be united with fine silk stitches and the smaller branches brought as near together as possible by the most careful suture of the wound. When union takes place without suppuration, these branches are able to unite and restore the muscular activity of the face. When the branches of the fifth nerve are separated in the wound, on the eyebrow, in the orbit, or on the cheek, they can be brought together by introducing a stitch through the adjoining tissues, and sensation can usually be expected in the course of two days or a week. Injury of the trigeminus, especially if followed by suppuration, is apt to result in painful neuroma, or in facial neuralgia, beginning at the point of injury, but this result may be looked upon as exceptional. Incised wounds of the

lid must be united with the greatest exactitude, beginning with the conjunctiva and passing forward to the skin incision. Incised wounds of the ear and nose require the most conservative treatment. The point or tip of the nose has frequently been successfully replaced and made to grow after being completely cut off. In one case the amputated portion of the nose was not found for several hours, and yet, after thoroughly cleansing and completely and perfectly stopping the blood on the stump, the piece was replaced and held by fine stitches and an adherent dressing over the nose and in the nostril, and union took place. In another case a medical student put the amputated nose at once in a normal salt solution at the temperature of the body and the patient was removed to a suitable place, the blood stopped, and the fragment replaced. Almost as good results have been obtained with amputated pieces of the ears. Failures are usually due to imperfect arrest of hemorrhage, or to sepsis. In the former case, the replaced tissue is separated from its nutrition by a clot of blood; and in the latter case, the infection spreads through the amputated tissue with great rapidity on account of its diminished resistance and imperfect nutrition. Such implanted or replanted tissues should be treated aseptically, and kept warm and moist and free from the slightest compression or tension.

When Stenson's duct is severed, or the parotid opened, a fistula is apt to follow immediately, or in the course of time a cyst appears, containing the parotid secretion. Either of these conditions must be looked upon with dread as they are frequently difficult to eradicate.

Gunshot wounds of the face are serious in proportion to the damage they do to the respiratory and digestive apparatus. One of the most serious consequences is protracted suppurative osteitis. In the Civil War there were 4,914 gunshot wounds of the face without known fracture, of which 58 died; 5 of these died of erysipelas, 2 of gangrene, 6 of pyemia, 7 of secondary hemorrhage—or in all, 20 of infections which would probably not occur under modern treat-

42

43. Successful chiloplastic operation for gunshot injury.

ment. There were 1,190 gunshot wounds of the orbital region, with 64 deaths; 3,312 gunshot fractures of the bones of the face, with 340 deaths; and 64 saber wounds, with 2 deaths. It appears that in 7 cases both upper and lower jaw were fractured. The upper jaw was most injured in 22 cases, the lower in 80 cases. In 27 cases the nasal, lachrymal, turbinated, or malar bones were most injured. On account of the great comminution of the fractures of the lower jaw, and subsequent infection and seques-

tration, the whole lower jaw has been frequently removed and plastic operations made necessary.

Burns of the face occur both as the result of explosions of inflammable liquids, and from the escape of superheated steam. The resulting deformities are about the same in either case. The scar tissue contracts and draws the remaining features out of shape. The eyes and nose are sometimes completely obliterated, and the mouth is rendered almost useless for speaking by the contractures which draw it out of place and hold it almost immovable. But few patients, fortunately, survive these terrible injuries. After the eschar has sloughed away, which is usually about two weeks after the scalding, the granulating ulcer can be covered by skin-grafts—after the method of Tiersch.

Fracture of the lower jaw occurs more often than that of the other bones of the face. It usually opens into the mouth, and is therefore a compound fracture. It seems to be rare in childhood and old age, and appears more frequently between twenty and thirty. It is ten times more common in males than in females. In about half the cases the fracture is single, and in the other half it is double or comminuted. In 75 single fractures, 25 were in the median line, 22 in the region of the incisor teeth, 15 in the region of the molars, and 12 were behind the teeth, or on the ramus. The line of fracture is usually vertical, or nearly so. The diagnosis is made by the pain on pressure and on movements of the jaw. This symptom is constant and well marked. The displacement of the teeth and hemorrhage on motion are also common symptoms.

Swelling and edema over the line of fracture is a symptom which can sometimes be observed. The dangers from fractures of the lower jaw are infection resulting in necrosis of the bone, non-union, and fistula leading from the necrotic bone out through the skin. The treatment consists in immobilizing the bone. This can sometimes be done by winding silver wire about the two or four adjoining teeth. Frequently this is impractical, and in these cases a rubber splint is made by the dentist which fits both upper and lower sets of teeth perfectly, and is perforated in the middle between the incisors for the insertion of a feeding tube. If the patient happens to have lost one of the incisors, or even a premolar, the splint is unnecessary. The jaws can be bound together by a bandage over the head, face, and jaw, and the patient can take food through a tube inserted in the opening left by the extracted tooth.

Fractures of the upper jaw are extremely rare, and are not usually followed by serious complication. The diagnosis is difficult, and there is no special treatment.

Fracture of the malar bone is of rare occurrence, and the diagnosis can be made only from the resulting deformity and the history of the injury. There is no treatment.

Fractures of the bones of the nose, and dislocation of the nasal cartilages, are among the most common injuries of the face. The diagnosis is made from the deformity, the hemorrhage from the nose, the obstruction of the nostril, and in a few cases the crepitus which follows attempts to replace the parts. Treat-

ment should be begun at once. The nostrils should be carefully cleaned, and any abrasion of the skin over the fracture should be made aseptic. The size of the nostril will dictate the instrument which should be used. The patient may be anesthetized or a local anesthetic applied to the mucous membrane of the nostril. Then a long, smooth, strong forceps, or a smooth, straight sound may be introduced into the nostril, and the nasal bones carefully but firmly raised and molded so as to give the normal appearance to the nose. This may be a little exaggerated with safety. The superior nasal cavity should then be packed with a long strip of iodoform gauze. This process must be repeated, if necessary, at intervals of three or four days. The swelling can be taken down by the use of hot applications.

Old fractures of the nose, leaving marked deformity, require surgical correction and present problems often of the most difficult solution.

FRACTURE OF THE ZYGOMA

This bone is broken less frequently than its prominence and brittleness would indicate. According to Matas, it occurred only twice in 3,125 fractures of all kinds in 111,802 patients in the Charity Hospital in New Orleans. This is at the rate of 64 fractures of the zygoma in 100,000 fractures of all kinds. Malgaigne never saw a case, and was able to collect only 5 doubtful ones, the earliest was that of Duverney in 1757. Agnew saw only 2 cases, both of them on the same day. Matas saw 2 cases in sixteen years.

Fracture of the zygoma, in a man aged 34; great deformity; elevation by means of silver wire suture over splint; complete recovery.

Dr. B., aged 34, was walking rapidly around a corner when he met a boy on a safety bicycle. The boy's head struck the doctor on the side of the head, producing a severe shock, but no concussion of the brain; the blow produced a loud report in the patient's ear, with slight nausea. He walked two blocks.

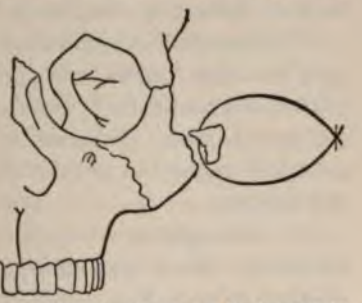
When the patient was examined he was pale and evidently suffering intensely. There was a marked depression or hole corresponding to the most prominent portion of the zygomatic arch about an inch back from the malar prominence. Evidently the arch had been fractured, and the displaced fragment had sunk one inch below the level of its malar and temporal processes. The depression at the broken level easily admitted the thumb and allowed it to sink into the temporal and zygomatic fossæ below the level of the fixed portions of the arch. There was no break in the skin, and little evidence of contusion. A fear of hemorrhage from a middle meningeal artery was entertained, but fortunately the force of the blow was broken by the arch and the thick tendon of the temporal muscle acted as a buffer. It was evident from the acute pain on opening and closing the mouth, and from the immobility of the displaced fragment, that the broken bone had been impacted in the temporal muscle itself.

The treatment was dictated by the pain, which

showed itself with every motion of the lower jaw, by the striking deformity, and by the probability of future anchylosis through rigidity of the temporal muscle.

Dr. Matas resorted to a new device: chloroform anesthesia was secured, and the usual antiseptic precautions were observed. A long, full-curved Hagedorn needle was inserted about one inch above the

44. Curved needle carrying traction wire under fractured arch.



45. Wire *in situ*, ready for traction to replace displaced fragment.

middle point of the displaced fragment and was carried well into the temporal fossa under the broken bone. The point of the needle was then raised and made to emerge about half an inch below the lower border of the broken arch. As the needle was pulled out, a strong silver wire about one foot long was drawn through the tract of the needle so as to form a metallic loop under the displaced bone. By twisting the ends of the wire together a loop was formed with which easy traction was made on the broken bone. The displaced bone yielded and returned to its normal position with a snap that was loud enough to be heard by the assistants. The contour of the arch was im-

mediately restored, and the fragment showed no tendency to displacement. Nevertheless, the wire loop was fastened over a well padded microscopical slide to act as a splint. On the following day a hard rubber splint was prepared by a dentist and substituted for the slide. The wire loop was removed on the ninth day, and there was complete relief from pain and no scar or deformity remained.

This fracture is found associated with other injuries, and has been known to be produced from a force from within the mouth. It is associated with a fracture of the malar bone. Fracture of this bone usually occurs a little beyond the middle of the temporal portion of the zygoma.

A mere glance is usually sufficient to make the diagnosis: in a few cases there is fracture without displacement. The upper border of the arch gives a firm attachment to the temporal fascia. This fascia will not allow the fragment to be displaced unless its attachment is torn away. When this is the case, the action of the masseter, which is attached to its lower border, produces downward displacement. As the broken zygoma is displaced inward and downward, it may be sunk as far as the sigmoid notch, where it may become locked with the coronoid process of the lower jaw.

Dr. C. L. Bower (Polyclinic, Philadelphia, 1885, p. 111,) reports an interesting case. M. F., aged 36, stepped on a long pole, which threw him down; the right side of his head struck the pole, producing a depressed fracture of the zygomatic arch. It caused considerable pain and swelling. On opening and shut-

ting the mouth a kind of friction sound and rubbing sensation was noticed at the seat of the injury. This gradually increased until it was with difficulty that he could close his mouth. While chewing a piece of meat he suddenly found it impossible to close his mouth, which remained open, with the teeth of the two jaws about one inch apart. He could, by an effort, separate the jaws a little further, but was incapable of bringing them together. The deformity resembled a dislocation. It was at this time that I first saw him. On examination it was found that the zygoma was fractured a little posterior to the suture, and that the posterior fragment was greatly depressed, with either a decided bend, or perhaps another fracture further back near the tubercle. The coronoid process of the inferior maxilla was caught against the depressed fragment, which accounted for the fixation of the jaw.

As it was impossible to reach the depressed fragment to elevate it, either externally or through the mouth, Dr. Levis made an incision of half an inch, just above the zygoma, which was then lifted with an elevator such as is used for elevating depressed fragments into position, which immediately allowed the jaw to close easily. I have not been able to follow the subsequent history of the case.

Clinically, the fractures of the zygoma must be classed as simple or compound, complicated or uncomplicated. In complicated fractures of the zygoma, the complications wholly overshadow the injuries of the little bone. In simple fractures of the zygoma, all authors agree that the bone should be immediately and permanently reduced. This conclusion is based

upon the fear of disturbance of mastication as well as in the certainty of permanent deformity. The open method of reduction has usually been recommended, but all experience as well as experimental research shows the difficulty of wiring so small a bone. The method adopted by Matas is preferable, and seems likely to be applicable in all cases, whether simple or compound. Reduction through the mouth is impracticable. This is shown by a case reported by Bellamy (Lancet, London, 1872, 1, 186):

A. B., aged 40, a man of unhealthy hydrocephalic aspect, applied at the hospital in January, 1872, with a severe bruise, the result of a blow with the fist, on the left side of the face; inability to open the jaw beyond a certain distance, and with what he described as a tooth sticking into his cheek. He said he could feel nothing on the left side of his cheek and gum, and that it was alike all cold.

Examination showed fracture of the zygoma, and most probably fracture of the zygomatic process of the temporal bone, with disarticulation of it from the malar, the dislocated end being forced down toward the cavity of the mouth, having apparently the buccinator and buccal mucous membrane only between its rough extremity and the finger.

An attempt was made at reduction by passing the finger into the buccal cavity and pushing the end of the bone upward and inward, but the pain was excessive. Moreover, even when something like approximation was attained, directly the masseter was put into action, the fragment assumed its former position. The nervous symptoms seemed to point to pressure

and implication of the middle and lower division of the fifth and its inosculations. He appeared to be, moreover, unable to inflate the side of the cheek corresponding to the accident, there being apparently pressure upon the buccal nerve of the lower division of the fifth. There appeared very slight deformity. On his next visit, January 5th, there was less pain, and he could open the jaw slightly, the other symptoms remaining much the same.

The literature on this subject is not very large. It may be looked up in the text-books and cyclopedias of surgery, and the various treatises on fractures, especially in Simpson, Hamilton, Gurlt, and in the Index Catalogue and the Index Medicus. Matas gives a bibliography. (Matas, R., Fracture of the Zygomatic Arch. New Orleans Medical and Surgical Journal, 1890, September.)

BIBLIOGRAPHY

Hamilton: A clinical lecture on fracture of the lower jaw. Hospital Gazette, N. Y., 1878.

Deaver: Surgical Anatomy, 1899.

CHAPTER IV

FRACTURE OF THE SKULL

Anatomy of the head as related to fractures of the skull; the blood supply; various forms of fracture of the skull; definitions; course of simple fracture; symptoms; diagnosis; treatment; indications; illustrative cases.

The character of the skull in various periods of life varies more than in other bones. In the new-born, the skull is almost like leather in its flexibility. In later life it becomes from year to year firmer and more brittle. The sutures gradually close, and some of them disappear entirely. In most parts of the vault the skull consists of two distinct plates of bone, separated in one place by the diploë, made up of blood vessels, and in another place by air-filled sinuses lined with mucous membrane, continuous with that of the nose and throat. In other places the skull consists of a single thin plate of brittle bone.

46. Vertical section of the skull, showing the sinuses of the dura mater.

The blood supply of the skull and dura is of the greatest surgical interest. The meningeal arteries lie so close to the skull, and even in canals or tunnels in

the bone, that fracture of the bone means rupture of the arteries.

The foramina at the base of the skull give exit to cranial nerves, and entrance and exit to blood vessels, that are injured by fracture at the base of the skull, or compressed by hemorrhage near the foramina.

47. The sinuses at the base of the skull.

The blood supply of the brain itself is also to be considered, especially in fractures of the base and in gunshot wounds.

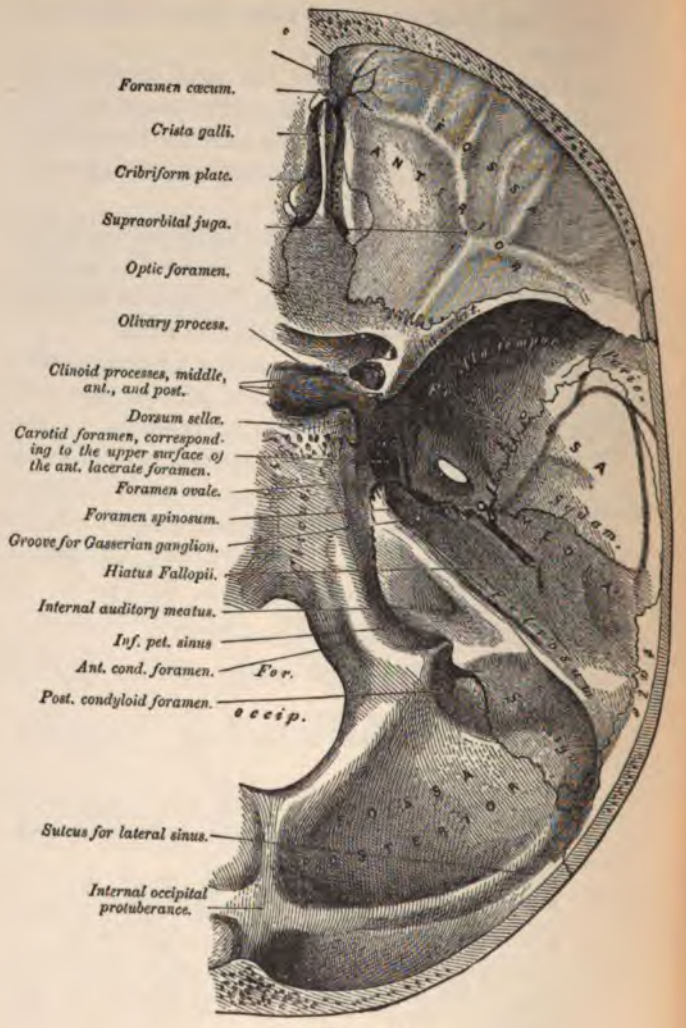
The anatomy of the meningeal spaces is of the greatest importance in relation to the spread of infection. All of these anatomical points must be considered in relation to the function of the parts concerned. The anatomy and physiology must not be separated.

FRACTURE OF THE SKULL

A. 1. Simple fracture of the skull. (Little danger of infection.)
   2. Compound fracture of the skull. (Great danger of infection.)
   3. Perforating gunshot wounds and fractures of the skull. (Great destruction of tissue and great danger of infection.)

B. 1. Fractures of the vault. (Accessible.)
   2. Fractures of the base. (Inaccessible.)

C. 1. Complicated fractures of the skull. (There are other serious injuries or conditions of the patient.)


Foramen cæcum.
Crista galli.
Cribriform plate.
Supraorbital juga.
Optic foramen.
Olivary process.
Clinoid processes, middle, ant., and post.
Dorsum sellæ.
Carotid foramen, corresponding to the upper surface of the ant. lacerate foramen.
Foramen ovale.
Foramen spinosum.
Groove for Gasserian ganglion.
Hiatus Fallopii.
Internal auditory meatus.
Inf. pet. sinus
Ant. cond. foramen.
Post. condyloid foramen.
Sulcus for lateral sinus.
Internal occipital protuberance.
occip.

48

2. Uncomplicated fracture of the skull. (There is nothing else the matter with the patient.)

D. 1. Produced by direct trauma. (Most fractures of the vault.)
2. Produced by indirect trauma. (Most fractures of the base.)
3. Produced by contra coup. (Rare.)

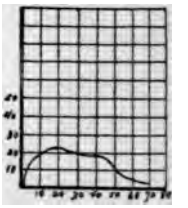
E. 1. Complete fracture. (Both tables are broken.)
2. Incomplete fracture. (Only one table broken.)

F. 1. Depressed fracture of the skull. (One or both tables fail to return to normal place.)
2. Fissured fracture.
3. Comminuted fracture.
4. Stellate fracture.

G. 1. The fracture is compound and therefore infected, fresh or old.
2. The fracture is accompanied by concussion of the brain.
3. The fracture results in compression of the brain, due to
   a. Depression of bone.
   b. To hemorrhage
      aa. From meningeal artery.
      bb. From sinuses.
      cc. From cerebral artery.
4. The fracture results in injury of cranial nerves.
   1. The olfactory.
   2. The optic.
   3. The motor oculi.
   4. The trochlear.
   5. The trigeminus.
   6. The sympatheticus.

7. The facial.
8. The auditory.
9. The glosso-pharyngeal.
10. The pneumogastric.
11. The spinal accessory.
12. The hypoglossal.

In 51,938 cases of fracture of bones of the body, as they occurred in the practice of various surgeons, there were 757 fractures of the skull, or 1.45 per cent. (Gurlt.) Out of 3,690 cases of all kinds treated in Cook County Hospital, in the first six months of 1890, there were 12 fractures of the skull. Out of 3,822 in the second six months, there were 50 fractures of the skull. Of these 62 skull fractures, 10 per cent were fractures of the base. The others were fractures of the vault. In 113 cases of fracture of the skull collected from the literature by my class, 108 cases specified the location of the fracture; 86 per cent were fractures of the vault alone; 6 per cent involved both base and vault. These fractures occur about nine times as frequently in men as in women; 60 per cent occur between 20 and 40 years.



49. Curve showing frequency of fractures of the vault in 1,113 cases collected successively from the literature.

The frontal is fractured in 44 per cent of fractures of the vault, the parietal is fractured in 40 per cent, the temporals in 12 per cent, and the occipital in 2 per cent.

A fracture of the skull is simple when the skin over the fracture is not open, or when the fracture has no

communication with the outside. A fracture of the skull is compound when it does communicate or open outwardly through the skin or into the ears, the throat, or the nose.

Fractures of the accessible portions of the skull are termed, for clinical convenience, fractures of the vault, while deep, inaccessible fractures are called fractures of the base.

Fractures of the vault are often complicated. Among these complications are other injuries received at the same time, such as fracture of the base, fracture of the bones of the leg or of the arm, crushing injuries, rupture of the bladder, emphysema due to injury of the lungs or pregnancy. In the study made by my class, 22 per cent presented some complication, the most common being fracture of the clavicle.

Fractures of the vault are produced both by direct and by indirect trauma, but most fractures of the vault are produced by direct blows, while fractures of the base are more often produced by indirect injury. Fractures of the vault tend to radiate into the base and then result in fracture of both vault and base.

50. Veins of the diploë, as displayed by the removal of the outer table of the skull.

A fracture of the vault is complete when both tables of the skull are broken, but since the outer table is more flexible

than the inner table the fracture is often incomplete, involving only the inner, vitreous table.

When one or both tables fail to return to their former place or places after a fracture, the injury is termed a depressed fracture of the skull. If the depression is great it results in compression of the brain, and all the symptoms that go with compression.

When the fracture of the vault occurs near a large blood vessel in the dura, it often produces rupture of an artery, vein, or sinus, and consequent hemorrhage, and then compression of the brain from effused blood.

Compression of the brain as the result of fracture is due to depression of the skull or to hemorrhage from an artery, vein, or sinus.

The course of simple fracture of the skull:

1. Uninterrupted recovery.

2. Depression and compression with loss of function, symptoms all subsiding rapidly, not to appear again.

3. Depression and compression with persisting symptoms.

4. Hemorrhage with slight symptoms disappearing after a time.

5. Hemorrhage with progressive compression and permanent symptoms consistent with life or going on to death.

6. Psychic symptoms coming on early.

7. Psychic symptoms coming on late. Epilepsy, irritability, insanity.

8. Secondary infection through the blood.

The symptoms and course of fracture of the skull without open wound of the scalp or injury of the

brain are of a rather unrecognizable character. They are best studied in cases where the skull has been trephined antiseptically for exploratory purposes. In such cases the fragments of bone are replaced and the aseptic scalp wound closed. The patient is usually unconscious of any pain in the skull or in the side of the head as the result of the operation. The parts are protected from pressure by the antiseptic dressing and the plaster or starch bandage which makes up the skull-cap. Sometimes there is a slight headache for a day or two, but nothing of any considerable importance. The same trifling symptoms might be expected to accompany simple fracture of the skull without injury of the brain. As a matter of fact, such cases are unknown. There is always more or less concussion of the brain, or *commotio cerebri*, and in every case of simple fracture of the vault, there is some injury of the scalp, with the reaction which necessarily attends its repair. The scalp is swollen, tender, and a trifle warmer than the skin elsewhere. The patient complains that his head is sore. In the greater number of fractures of the vault, the patient is unconscious immediately upon receiving the injury, through that strange manifestation known as concussion of the brain. This condition lasts from a few seconds to twenty or thirty hours. It is not to be supposed that this manifestation is unattended by anatomical or histological lesions, and the repair of these lesions must certainly be accompanied by some interference with the functions and sensations of the brain and its coverings. Therefore headache, as the result of fracture of the skull, might naturally be expected, and it is

found to be present in a large proportion of the cases.

Dizziness is another symptom which is probably caused in the same manner. It is nearly always present immediately after the injury, or after the disappearance of symptoms of concussion. It is combined with inco-ordination, which is manifested upon the patient's first attempt at motion.

A slow pulse and one so weak as to be imperceptible, and arrest of respiration, have been observed immediately upon an injury to the head resulting in fracture of the skull, but usually these functions are quickly resumed and carried on in a normal manner. In a few cases the respiration has been so retarded as to result in edema of the lungs, followed by labored breathing and frothing at the nose and mouth, but such severe symptoms are rather the result of injuries to the brain than of fracture of the skull.

There is no tendency to motion or displacement in simple fractures of the skull, and they heal rapidly without much disturbance and with only slight callous formation. There is sometimes headache, and in rare cases other psychic symptoms. The infection of a simple fracture and meningitis is too rare and improbable an event to be worthy of mention. After the symptoms of concussion have passed off, there is only slight discomfort, and in two weeks all is well.

The diagnosis of simple fracture of the skull is made by one or more of the following signs or symptoms:

1. Depression of the surface of the bone, commutation, fissure (difficult in the temporal region and elsewhere, where the muscles are thick).

2. Pott's puffy tumor.

3. Auscultatory percussion.

4. The escape of cerebro-spinal fluid into a translucent tumor under the scalp, aspiration (Howard Lancet, 1896).

5. Symptoms of compression, loss of cerebral function.

The diagnosis of compression from depressed bone or hemorrhage depends on localizing lesions, paralysis, aphasia, blindness, deafness, and inco-ordination, combined with the evidence of lesions likely to give rise to these conditions.

In making the diagnosis great care must be taken not to mistake for fracture congenital malformations of the skull, such as abnormal sutures and wormian bones, or the results of old pathological conditions, such as syphilitic or osteomylitic necrosis.

The treatment of cases of simple, uncomplicated fracture of the skull is symptomatic. The patient should be immediately wrapped up and carried to a warm bed and surrounded with warm water-bottles. The head and chest should be slightly elevated and cold applications should be applied to the head with an ice-bag or an ice-water coil. He should be carefully watched with stimulants at hand until all symptoms of concussion pass away. The scalp and hair should be thoroughly shampooed and carefully watched for the appearance of infection which comes on so insidiously in the unyielding tissues of the scalp. When the swelling and edema have subsided, or at the end of three or four days, the patient can be given some freedom, but it is best to protect the head and

thoroughly immobilize the skull by means of a skull-cap made of starch, or plaster of Paris bandage. Full liberty should not be given the patient until after union has taken place, and certainly not earlier than two weeks after the injury. Psychic symptoms appear at two stages in the course of these injuries. They show themselves during the first few hours as epileptic-like convulsions or delirium, and again weeks after the injury as Jacksonian epilepsy or disturbances of cerebration.

Probable fracture of the left vault; rupture of middle meningeal artery, and hemorrhage over arm and leg centers; paralysis of the right arm and leg, and general hebitude; expectant treatment; partial recovery.

In November, 1899, I saw Mr. T., 42 years old. He gave a good family history, and a personal history that was unrelated to the present injury. On July 20, 1899, late at night, he attempted to get aboard a rapidly moving street car. The next morning he was found on the ground. He had a scalp wound just a little to the left of the vertex. He remained unconscious twenty-four hours, and then semi-unconscious for two weeks. The patient did not know what condition he was in during this time. There was complete paralysis of the right arm and leg. He could not pick up small objects with the right hand, from that time to this. He could walk and stand on the right leg after the first week. He had poor memory, was morose, and had melancholia.

The patient has a sad, expressionless face. He speaks inarticulately, poorly, and hesitatingly. He

feels a constant pressure over his head, and has pain down his back. He does not see distinctly as formerly, and does not care to read or talk; gets tired and forgets what he is doing. His memory of the past is not good, and he is especially forgetful of names and dates. He does not sleep well, but has a good appetite and weighs as much as he ever did. The muscles on the right side of his body twitch involuntarily every little while.

The plantar reflexes are more marked on the right, producing extension of the toes and flexion of the foot on the leg. The cremasteric and abdominal reflexes are normal, the knee jerk is exaggerated, especially on the right side. The sense of heat is more marked on the right than on the left leg. His pupils are equal and react to light and accommodation. He sways a little from side to side when he has his eyes closed, and has difficulty in walking in the dark. His tongue is protruded in a straight line. His hearing is 12 in his right ear to 8 in his left. His total strength was 1985, 580 upon the right, and 1405 on the left.

The diagnosis of fracture of the skull and hemorrhage from the left middle meningeal artery was made. An operation was suggested, but refused. He was treated by hydrotic measures, massage, and faradization of the muscles on the right side, a vegetable diet, and light gymnastics. This was continued with gradual improvement until January 3d, when his mental condition was much improved, his strength reaching a total of 5,415, the right side being equal to the left. He returned much improved.

The indications for treatment of simple fracture of the skull depend upon the prognosis.

When there are no symptoms either from depressed bone or hemorrhage, the treatment is expectant.

Expectant treatment consists in making the head, ear, nose, and mouth clean for fear of fracture of the base, putting the patient in a still room in a semi-recumbent position, and applying cold to the head, either by an ice-bag or by cold wet compresses. The urine and blood should be examined to exclude general diseases, and a mild laxative given to diminish the blood pressure. The patient should be put upon a light or restricted diet, and all stimulants denied. This treatment should be continued for several days, and even for two or more weeks, as hemorrhage has been known to follow simple fractures several days after the injury. The patient should not be left alone for fear of psychic symptoms, which are most apt to show themselves during the first week.

When there is compression from any cause, this cause must be removed; if from depressed bone, it must be elevated; if from hemorrhage, the artery must be tied; if from general contusion of the brain, time and depleting treatment must be trusted to remove the pressure and restore the pulse and other vital functions.

Acute mania following a trauma; operation 42 days after injury; history of injury; concussion two hours; marked psychosis at once.

L. F., a carpenter; aged 35 years; married; family history good; father and mother, two brothers, and one sister living, all in excellent health. On Septem-

ber 17, 1892, the patient received a blow on the top of the head, about the interauricular line, from a brick which had fallen about sixteen feet. He was in a stooping posture, and the blow, which was a glancing one, knocked him over. He was unconscious for about two hours. During the night he became delirious, got up, dressed himself, and started out with his gun. This delirium lasted the greater part of the night, but toward morning he became rational. The next evening he again wished to go hunting in town. He also insisted on sending his children to school in the late hours of the night. He had constant headache about the base of the brain, and a few days after the injury his sight became so affected that he had to be led to his physician's office. This condition lasted about four days. He had several attacks of mild mania, which were brought on by the least excitement. He was extremely restless at night, and the administration of narcotics had little effect. An operation was performed on October 30, 1892, for fracture of the skull and irritation of the brain.

There were no adhesions, but the dura was somewhat congested. On the morning following the operation the patient was able to smile, something he had not done during the entire time he was under observation before the operation. He made a good recovery, and is working at his trade daily. The length of time which has elapsed since the operation fully warrants the statement that the patient has been entirely cured.

COMPOUND FRACTURE OF THE VAULT OF THE SKULL

By compound fracture is meant a fracture communicating with the external world through a wound in the soft parts. All penetrating wounds of the skull, such as bayonet wounds, gunshot wounds, wounds with knives, forks, pieces of glass, and other cutting instruments, are compound fractures to every intent and purpose. Compound fractures of the skull differ from simple fractures of the skull only in adding the danger of infection.

Compound fractures of the vault are usually due to direct violence. The patient falls and strikes on the head, or the foreign body, the ax, spear, piece of machinery, or the moving body, strikes the vault and produces a scalp wound and communicating fracture. Since the introduction of heavy machinery and rapid transportation and high buildings, the number of compound fractures is greatly increased. Gunshot wounds are to all intents and purposes compound fractures, but they have some peculiarities requiring special consideration.

The course of compound fracture of the skull depends on the presence or absence of infection. If the skull wound is infected at the time of injury, or at any subsequent time in the course of the healing of the scalp wound, a meningitis results which is almost invariably fatal. The difference between the course of the simple and the compound fracture of the skull depends upon the fact that all compound fractures, with rare exceptions, are infected. The course of such a compound fracture is illustrated in the following case:

MACEWEN. *Pyogenic infective diseases of the brain and spinal cord, p. 57.*

In a case which occurred in 1879, two punctured fractures on the vertex of a young man were produced by a blow with a pair of tongs. The external wounds were insignificant, but the fracture exposed the dura, and one of them penetrated to the inner membranes, as indicated by the escape of a small quantity of cerebro-spinal fluid. Three days after the injury (during which, though not at work, he was going about out of doors) he had a rigor followed by high temperature, and lepto-meningitis, from which he died on the fifth day after the injury. The post-mortem showed that his whole cerebro-spinal system was affected with lepto-meningitis, spreading from the punctured fracture which had penetrated the dura. The whole of the cerebral pia mater was deeply injected, many of the pial vessels were thrombosed, especially about the point of penetration. At this part, and for a couple of inches round it, there was a small purulent exudation.

The prognosis of unattended or improperly treated compound fractures of the skull is almost invariably unfavorable. With early and proper treatment, compound fracture of the vault, without injury of the brain substance or rupture of the meningeal arteries or other complications, is usually favorable. When fracture of the vault is complicated by other serious injury, the prognosis is modified accordingly. The following case illustrates this point:

A girl eight years old fell from a porch and struck on a dirty catch-basin (cesspool) cover, producing a

linear, compound, slightly depressed fracture of the vault, three inches long, just above the right ear. The child was unconscious for an hour after the fall. The pupils were equally dilated, the respirations 12, and the pulse 70 per minute. After a time this concussion gave way to sub-consciousness. The scalp did not bleed much on account of the contusion of the edges of the wound. The head was completely shaved and scrubbed. The edges of the wound were trimmed off with scissors, and the wound washed out. The edges of the fissure were distinctly seen to hold hair and filth in their grasp. The child was anesthetized and the edges of the fissure chiseled away, leaving the dura bare over the whole length of the wound for a width of $\frac{1}{2}$ cm. The dura was then slightly depressed and its surface washed off with a stream of dilute sublimate solution, $\frac{1}{4000}$. Care was taken to remove anything under the edges of the bone. All hemorrhage was stopped. The dura was not broken or opened. The scalp was brought back in place and sewed together with interrupted silk stitches. The wound and whole head was covered by an antiseptic dressing held in place by a skull-cap of starch bandages. The child slept well the first night, and made an uneventful recovery. The stitches were removed on the third day, when a collodion dressing was applied. The skull-cap was worn three weeks to prevent accidental injury to the uncovered brain.

In spite of the most terrible injuries of the skull and brain, some cases make good recoveries. This is so especially in gunshot and other penetrating wounds. The following case is suggestive:

A child, two months old, fell from a baby carriage from the top of a porch, eight feet above the ground. The steel arm, which held the sunshade, penetrated the skull just above the right orbit, entering the brain to the distance of about three-quarters of an inch, as indicated by the blood on the steel arm. It then seemed to have been forcibly pried out. The rod was three-eighths of an inch in diameter, rough and jagged. There was loss of about a dessert-spoonful of brain substance. The wound was a lacerated, horrid gash. The shock was profound. The child was almost insensible, deathly pale, and pulseless. The wound was sewed together in hopes of making a better looking corpse. A little drainage, however, was put in. The shock was so profound that the child did not cry. No anesthetic was necessary. There was rise of temperature during the following day to 102° F., and discharge of blood and cerebral matter for a couple of weeks, and the child seemed perfectly normal. (C. H. Mastin, in the Medical News for July 13, 1895.)

This case is one in which, although infection evidently took place, the meningitis obliterated the meningeal cavity and the slight infection of the brain itself recovered by drainage.

The most dangerous wounds are often those that present the least threatening aspect at the beginning. A small scalp wound leads down to a trifling fracture. The patient is never unconscious, and hardly recognizes the injury except by the blood. The scalp wound heals rapidly, and only after ten days or a

month do the symptoms of intracranial infection come on.

The following case ought to be a warning to careless doctors: J. C., a man, married, age about 30, laborer, was admitted into Dr. Fenger's service at the Cook County Hospital, December 19, 1888, with the following imperfect history:

Three weeks previously he was hit on the forehead with an ax. He suffered no special and immediate inconvenience, but was able to be about on his feet. The wound in the forehead was treated by a physician with "salves and cotton," and it healed in about ten days. A few days after the injury, the patient complained of headache. He was noticed to act "queerly"; periods of unconsciousness, or stupor, were followed by restlessness, mental depression, or irritability. Immediately previous to admission the stupor had become more marked; nevertheless he walked into the examining room of the hospital.

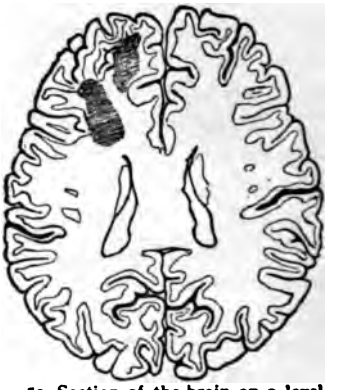
Examination shows a well-developed man, deeply unconscious, who cannot be roused to answer questions. He lies quietly and breathes regularly. The skin is moist and warm; the tongue clean; the pupils are alike, neither dilated nor contracted, and responsive to light; the lungs and heart present nothing strikingly abnormal; the pulse is soft and slow, beating 56 times per minute; the respirations are 20 to the minute; the temperature is 98.5° F. There is no paralysis, and there are no localizing symptoms. The urine passes involuntarily. There is a faintly reddish, linear cicatrix 4.5 cm. long, commencing at a point

4 cm. above the nasal eminence and running vertically ½ cm. to the right of the frontal suture.

Ten hours after admission, Dr. Fenger made the following operation under classical antiseptic precautions. Anesthesia was not necessary. An incision was made through the cicatrix down to the periosteum, which with the soft tissues and skin was reflected on either side and held back with retractors. This dissection exposed a linear fissure in the bone 3 cm. long, running directly under the center of and parallel with the cicatrix in the skin. With the hammer and chisel, an area of bone 1.5 cm. square was now removed at the right of the fissure and the dura mater exposed. The brain was seen to pulsate. Several punctures into the brain with the exploring needle failed to bring any pus or fluid of any kind. A second similar area of bone was then removed at the left of the fissure, leaving a small, vertical bridge of the inner table between the inferior and superior margins of the opening in the frontal bone, and embracing the attachment of the longitudinal sinus. Between the outer and inner tables on the left side of the fissure there was found a small collection of rather thick, yellow fluid which was scraped away. The dura bulged into this second opening and the brain pulsated. An exploring

51. Outer aspect of left hemisphere.

needle was then introduced into the left frontal lobe, and about 2.5 cm. beneath the surface, pus was reached. The dura was now incised, a Billroth forceps passed along the needle, and an ounce or so of pus evacuated. A medium sized rubber drainage tube was then introduced and the cavity irrigated at a very low pressure with warm boracic acid solution. The wound in the soft parts was packed with iodoform gauze, the head enveloped in an antiseptic dressing, and the patient put to bed in as good a condition as before the operation. Soon afterward the temperature began to rise, the pulse to increase in frequency, the coma to deepen, and in ten hours the patient died. Just before death the temperature was 108° F., and the pulse 174 to the minute. Autopsy twelve hours after death. Examination of the head only could be made. The inner layers of the dressing and the iodoform gauze were stained with blood. The dura mater over the anterior superior surface of the left frontal lobe was thickened, and quite firmly adherent to the pia mater, which again peeled off with some difficulty, and brought away with it small pieces of brain tissue from the summits of the flattened convolutions. The brain here seemed softer than in the corresponding



52. Section of the brain on a level with the corpus callosum.

locality of the right frontal lobe. The drainage tube entered the frontal lobe through the anterior surface of the superior frontal convolution. Along its anterior wall lay a stringy blood-clot which was not of sufficient size to at all obstruct its lumen; about 2 cm. from the anterior surface of the brain it entered a cavity, the walls of which were irregular and composed of cerebral tissue lined with a layer of coagulated blood of varying thickness. The walls were very nearly in contact with each other. When distended, this cavity would be about as large as a walnut. It was separated from the longitudinal fissure by a wall of apparently healthy brain tissue about 2.5 cm. thick. To the left of and posterior to the empty cavity was a second and larger abscess, containing about two ounces of thin, greenish pus. It was separated from the empty one by a layer of cerebral tissue, 1.5 cm. in thickness at its thinnest part. Both lateral ventricles were empty, and in all other respects the brain appeared normal. (Dr. Ludvig Hektoen, House Surgeon, Cook County Hospital. In the North American Practitioner, Vol. I., 1889, p. 31.)

This case is typical of the ordinary course of a compound fracture of the skull. The formation of cerebral abscesses seems to be more frequent when the opening in the skull is large enough to admit infection, but not large enough to give adequate drainage to the infected brain tissue.

Ernest Laplace, of Philadelphia, reported in the Medical News of December 5, 1891, the following interesting case:

A boy, ten years old, while playing on the lawn,

fell upon the paling of a low iron fence. The steel penetrated the left orbit between the inferior ridge and the eyeball. The child was found a few minutes afterward unconscious, with the iron still in the wound. He was removed by a servant, and was examined five hours afterwards. At that time there was coma, right hemiplegia, left facial paralysis, complete aphonia; the respirations were 30, the pulse 140, the temperature 104½° F. Immediately above and about the center of the left orbital ridge was an incised wound, about one-quarter of an inch wide, from which oozed a little blood. An exploration of the wound was determined upon. The patient was etherized, and the cutaneous wound was slightly enlarged. The handle of the Graefe cataract knife, inserted into the wound, sank almost by its own weight to a length of three and one-quarter inches into the wound, taking a direction toward the vertex and the middle line.

Inasmuch as no spiculæ of detached bone could be detected, the probability was that the instrument passed through the sphenoidal fissure, thence entering the base of the brain. The eye was apparently uninjured. There was, however, complete anesthesia. The pupil was dilated and insensible to light. Treatment by venesection, morphine, quinine, strychnine, and other stimulants not controlling the symptoms, trephining was resorted to thirteen days after the accident.

From the direction taken by the instrument it was evident that it had penetrated the middle fossa, and that hemorrhagic clots should be sought for in that locality. The patient being etherized, a horse-shoe

incision, three inches long, was made in the temporal region, down to the level of the zygomatic arch, and a three-quarter inch segment removed, consisting of the temporal bone and a small fragment of the sphenoid; the dura mater appeared much congested.

To reach the center of the base of the brain for the removal of the suspected clot, a miniature egg-beater, consisting of four loops of platinum wire, had been improvised; this was perfectly malleable, and could be insinuated between the dura mater and the skull without wounding the cerebral structures. Having reached the cavernous groove, the instrument could be pushed no further; it was then turned on its axis for the purpose of catching the coagula in its loops. This was effectually accomplished, and about a teaspoonful of clotted blood was removed piecemeal.

Whilst dragging more out, considerable venous hemorrhage took place, most probably as the result of the removal of the clot that had occluded the injured cavernous sinus.

The trephined opening was immediately plugged with iodoform gauze, and a graduated compress applied over it, secured by a tight bandage about the head.

The patient reacted well from the operation; movement was restored, and speech was resumed.

The improvement was steady and progressive. At the end of three months the patient could sit at table. A secondary plastic operation was performed to close the wound remaining.

Six months after the accident the patient had equal use of both inferior extremities. He was able to stand and make a few steps without support. The pupil of

the left eye was somewhat contracted. There remained anesthesia of the eye and internal strabismus, indicating the existence of an injury to the ophthalmic division of the fifth pair, which supplies sensation to the eye, and an injury to the sixth pair, which supplies the external rectus, thus corroborating the suspicion that the foil had penetrated the sphenoidal fissure. The continued improvement warrants the hope of ultimate complete recovery.

In this case the fracture was followed immediately by compression due to hemorrhage, with loss of function of a great part of the brain, and it was only relieved by sufficient enlargement of the opening to allow the removal of the blood clots. Infection evidently did not take place, or it was very superficial.

Charles L. Scudder, of Boston, in the August, 1896, American Journal of Medical Sciences, reports the following case:

A boy, nine years old, was struck on the head by a brick falling from a height. He was seen immediately after the injury, at the hospital, and found to be conscious. He answered questions naturally. There was a large scalp wound over the parietal bone and a little anterior to the parietal eminence to the right of the median line. The bone beneath the scalp wound was fractured and depressed into the brain-substance. The left arm and the left leg were completely paralyzed to motion; sensation was present. The right pupil was dilated. The right upper eyelid dropped. There was a sore in the right cornea. Immediately after the injury the temperature was 96° F., the pulse was 74, the respiration was 26. When examined one

hour after the accident the pulse had fallen to 68, he had vomited once, and had been somewhat nauseated.

The operation for elevation of the depressed fragments of bone was done under ether. The fragments of bone removed were about the size of a silver half-dollar. There was no fissure in the skull. The dura mater was torn and the brain slightly lacerated. Upon elevating and removing the depressed bone, hemorrhage occurred from the vessels of the dura mater. The depressed bone was not replaced. The dura was left open, and the cavity was drained by a wick of gauze, which was removed upon the third day

A few hours after the operation the boy was perfectly conscious, as before the etherization, and the pupils were normal, and motion had returned in the paralyzed limbs.

Three weeks after the operation, a small, granulating wound remained, and there was a slight tendency to hernia cerebri.

Four months following the accident the boy's condition was as follows: The wound was nearly healed, but continued to discharge at times. He walked naturally. There was no paralysis of arm or leg. No mental symptom was present.

The interesting and unusual fact in this case is that after a blow sufficiently severe to cause a depressed fracture of the skull, and paralysis of one-half of the body, the patient remained conscious, *i. e.*, there was no concussion of the brain.

This case is interesting on account of the fact that the compound fracture of the skull was attended by compression of the brain, due to a depression of the

fracture. The trephining was done to relieve the compression, and at the same time it accomplished the very purpose for which trephining is done, namely, prevention of suppurative disease inside the skull. It is evident that the long continued open wound was due to infection.

OWINGS, J. HOOD, M.D., Deer Lodge, Montana. *A case of depressed fracture of the skull in a boy; profuse hemorrhage; operation; recovery.* (*The Medical News.*)

I was summoned late in the afternoon of May 6, 1894, to go fifty miles to see a boy, aged ten years, who had been thrown from his horse, dragged some distance, and kicked in the head; the accident having occurred about 5 P. M. on the afternoon of May 5th. Arriving at the place of destination about 3 A. M. on the morning of the 7th, I found the lad in a semi-conscious condition, with a large contusion and a very sensitive vertical scalp wound back of the left ear. His pulse was 125, the temperature 97 degrees, the respiration 26 per minute, the pupils dilated, and with partial paralysis of the bladder and lower extremities. As I could obtain but scant lamplight, and there seemed to be no immediate danger, I concluded to await daylight.

At 8 A. M., everything being in readiness, ether anesthesia was obtained, and I found that a large area of the skull was greatly depressed. The scalp being shaved, the vertical incision was extended to about two and a half inches in length, and a horizontal one made over the central portion of the contusion at right angles to the former, and two and a half inches long.

The periosteum was removed with a raspatory, exposing an extensive irregular comminuted fracture, composed of five pieces, and beginning just posterior to the junction of the middle of the concha of the ear with the scalp, and extending backward and upward for a distance of about two inches.

By the use of the elevator and sequestrum forceps, four pieces lying farthest from the ear were removed without any difficulty and with no untoward event. But when a piece lying close to the ear was removed, there was a sudden and alarming gush of dark blood, which could only be staunched by keeping the finger pressed against the dura. So great was the hemorrhage that it was impossible to tell whether the sharp bone had injured the brain substance or simply cut into one of the sinuses of the dura. In a few moments I was informed by an attendant that the pulse at the wrist had ceased to beat. I at once had given, hypodermically, strychnin, gr. $\frac{1}{60}$, glonoin, gr. $\frac{1}{100}$, and followed by m. 60 of old brandy. Meanwhile the wound was examined carefully for any debris, and thoroughly irrigated with warm mercuric-chlorid solution, $\frac{1}{4000}$. A compress made of sublimate gauze five-eighths of an inch in width was placed over the injury to the dura, and held firmly a few moments, and then a second compress, somewhat larger, of the same material, against the first, with the end left so as to protrude and afford drainage. The periosteum was now stitched together with catgut, and the scalp with iron-dyed silk. Iodoform dressings were applied externally, and the head bandaged.

There being feeble pulsation at the wrist, the pa-

tient was now put to bed, and hot water-bottles were applied. As soon as the little sufferer became conscious, he complained of considerable pain, and was given one-eighth of a grain of morphine, hypodermically; he then went to sleep for three hours.

At 9 o'clock P.M. the child was awake and perfectly conscious; had voided urine; the pulse was 110, the temperature 99 degrees, the respiration 20 per minute. He took a glass of warm milk, and was given ten grains of sulphonal. On May 8th the child had had a fairly good night, had taken beef-tea and milk, had voided urine, and his temperature was 99.5 degrees, and his pulse 100. On the third day the dressings were changed, and one piece of gauze was removed. The remainder of the gauze was gradually removed in a few days. There was some sloughing of the scalp, but healthy granulation took place, and an uninterrupted recovery followed.

HITCHCOCK, C. W. *A case of depressed fracture of the skull without injury to the inner table; operation; recovery.* (*American Lancet.*)

J. B., Pole, laborer, aged about 30, a rugged and healthy appearing fellow, on February 28, 1893, fell into difficulties with a fellow-laborer, who, when his back was turned, dealt him a blow with an iron sledge-hammer over the right parieto-occipital region, knocking him senseless. He rapidly recovered consciousness, and was taken to Harper Hospital, where he was disposed to make light of his injury. Examination revealed a rough and ragged scalp wound, at the bottom of which could be felt a depressed area, of

irregular shape, about one and one-quarter inches by three-quarters of an inch. An anesthetic was given, the wound enlarged, trephine and elevator carefully used, and the depressed bone removed. Although the outer table seemed depressed to the depth of one-sixteenth to one-eighth of an inch, the inner table was perfectly firm and apparently uninjured. The man made an uneventful recovery, developing no serious symptoms, and left the hospital one week after his accident, with the wound nearly healed. This case is of interest as showing the use of the diploë in preserving the integrity of the inner table, and it also shows an extraordinary thickness of the diploic tissue. It is owing to this, I think, perhaps also combined with a most astonishing power of resistance of the outer and inner tables, that this man was spared a compound depressed fracture which might have entailed the most serious results.

Fractures elsewhere in the body usually give immediate evidence of their existence, and ordinarily diagnosis is obvious. Not so, however, in many cases of fracture of the skull. Patients have been received into hospitals with evident injury to the head, kept under trained observation for a few days, and allowed to go out with no diagnosis of fracture, only to develop, within a short time, serious symptoms, resulting from abscess at the site of existing fracture, or from slowly increasing pressure from intracranial effusions of blood or serum. Later the diagnosis of the fracture has been established either by operative procedure or on the post-mortem table.

PARK, ROSWELL. *Fracture of the base of the skull.* (*Medical News, March 21, 1896.*)

The patient was struck yesterday by a belt-line train. He suffered severe contusions about the head, and he has been bleeding from the ears and nose, so that the question has arisen as to whether there is a fracture of the base of the skull. If there is a depression of the outer table, we shall know where to look for a possible depression of the inner table also, yet we must bear in mind that one table may be broken without a corresponding lesion of the other. If the inner table be broken, a meningitis may develop on account of the irritation caused by the pulsation of the brain against the sharp edge of the broken bone; again, if an acute meningitis is not thus caused, a localized chronic form may develop, with thickening of the membranes and sclerosis of the cortex in immediate contact, and then we have all the wound. Now, after biting off the margins of the bony opening with the rongeur, I have exposed the smooth, shining surface of the dura, from which the brain protrudes in a mass as large as a hickory-nut. The pulsation can be plainly seen in the protruding cerebral tissue, but not in the dura. Most of the hemorrhage comes from a vein in the dura, and this I will ligate with fine catgut.

The suspicion of fracture in the middle fossa of the skull, on account of hemorrhage from the ear, renders the prognosis much more guarded than it otherwise would be. There is some dilatation of the pupil on the right side that makes me suspicious of a clot on the opposite side of the brain. Still in the absence of

paralysis, I do not feel justified in trephining on the other side. We shall therefore await developments. The pulsation in the brain is beginning to be more free; it is slow, corresponding with the pulse, 40 to 50.

There is some hemorrhage from the margins of the bone, which I shut off by pinching the bone together with forceps. Some little bleeding points that remain, I close by pressure with a sharp pointed probe.

In a case like this, when it is certain that there will be some inflammatory exudate, it is a great mistake to tightly sew up the dura. By so doing you increase the pressure of the brain, and to that extent defeat your object in operating. As the exudate organizes, the wound in the dura will unite. Neither do I believe that there is any necessity in cutting off the protruding mass of brain tissue. I shall simply tuck in gauze so as to cover the dural wound, and then dress the remainder of the wound in an antiseptic manner, uniting the scalp in part, but leaving room for drainage.

I have seen two or three cases of undoubted basal fracture which recovered without operation, and in which, from the pressure signs, there must have been some hemorrhage. Laplace, of Philadelphia, has recently operated on such a case, churning up the clot and evacuating it; but it may be questionable whether the case would not have recovered without operation, and thus far we have very little precedent in regard to operations on the base of the skull. It does not seem to me that the pupil is as much dilated as when I began the operation, and this I take to be an indication that the pressure has been relieved.

SMITH, PERCY R., Sunny Brook, Md. *Compound fracture of the skull, with loss of brain tissue; recovery.*

On September 5, 1892, Frederick Hanf, aged ten years, was kicked in the forehead by a horse on the farm of his parents, and brought to his home apparently dead. The family physician was hastily summoned, and after seeing the condition of the patient, I was called in consultation. Upon my arrival I found my colleague thoroughly satisfied that death would soon end the scene, and little disposed to take any steps whatever to repair the damage. Upon examination I found a compound fracture of the frontal bone, above the right supra-orbital ridge, about three inches in length, and very much the shape of the horse's hoof. Through this opening protruded portions of the brain, and on the boy's hat, brain substance was scattered. The heart-beat was scarcely perceptible, and seemed fluttering, so we at once gave a hypodermic injection of nitroglycerine (gr. $\frac{1}{100}$) and in half an hour administered thirty drops of tincture of digitalis. In a short time the heart began to show signs of activity, and we decided, after some argument, to give chloroform and remove the shattered bone as far as possible. We succeeded in removing a few small pieces, but found the table of bone so firmly depressed from the violence of the blow as to make it impossible to lift it to its proper position. Previous to the administration of the anesthetic, the boy was beginning to regain consciousness, and there seemed no symptom of any paralysis. While at work, por-

tions of the disorganized brain ran out, and our calculations were that he lost over an ounce of brain substance. We then thoroughly asepticized the protruding brain substance and the wound with bichloride of mercury (1 to 3,000), and by careful manipulation succeeded in getting it back into the cranial cavity. Then a carefully prepared drainage tube of large size was laid the entire length of the wound, and extended about two inches above and below the injury, and the external soft parts were brought nicely together with silk stitches. A compress, thoroughly soaked in bichloride (1 to 2,500), was then laid over the entire injury, with directions to the nurse to constantly keep it wet with the solution, and the boy was put to bed to die, as we reasonably supposed. In this we were mistaken, for at our next visit, twelve hours later, the boy had rallied sufficiently to answer questions intelligently.

We applied no dressing whatever, other than the gauze soaked in bichloride, and ordered Epsom salts until the bowels were thoroughly emptied. Each day thereafter a laxative was administered as a precaution against constipation, which we suspected. A strictly milk or fluid diet was ordered. This treatment was continued for ten days, when it was gradually discontinued. His recovery was uninterrupted, which we considered miraculous at least. No fever or any signs of inflammation showed itself during the entire treatment, and the only thing necessary at each visit, we found, was to move the drainage tube back and forth to allow of the escape of any secretion collected about the point of insertion. The boy, in a few months,

entirely recovered, and has since been attending school, where his teacher informs me he is as capable of learning as ever before.

Comparing this case with the theories of eminent authorities, what do we know after all about brain injuries and diseases? It proves conclusively that even in the most severe injuries of the brain, where the patient is young, and none of the important centers are involved, we may hope for a satisfactory recovery if the case is treated by the most rigid antiseptic methods. No similar case, no matter how severe the injury, should be entirely despaired of if the most recent antiseptic treatment is strictly enforced.

I am aware that criticisms would be just and proper for my neglect in not elevating the depressed bone but for the fact of the persistent opposition of the family and friends to any operative procedure in that direction. I was therefore compelled, in deference to the wishes of the relatives and others, to employ other than radical measures for relief.

I present the patient to you for examination, and ask if we may not expect some cerebral trouble in after years, when we consider the injury the brain has received, and the depressed condition of the frontal bone as it now presents itself. Whether the line of treatment I have indicated was the best is not for me to say, but judging from the result, I am satisfied we did the best for the patient under the then existing circumstances.

These cases illustrate the course of compound fracture of the vault. The injuries which go under this name differ much in severity. They are often compli-

cated by the most serious injuries in other parts of the body; sometimes by delirium tremens and, rarely, by infectious diseases, such as pneumonia or typhoid. The injury is apt to happen to the insane and in epileptics. Fracture of the base so often accompanies fracture of the vault that they can be considered separately only in a systematic or theoretical way. Clinically they blend together.

The prognosis in compound fracture of the vault is always guarded if not always grave. Without treatment, only a small proportion recover. Under modern treatment, a great many live, and a large part of these are sound, bodily and mentally.

It is the duty of the physician to make a complete and exclusive diagnosis. This should not only say that the patient has a scalp wound and connecting fracture of the skull, but that he has nothing else the matter with him; that is, that the compound fracture is uncomplicated. The condition of the kidneys, heart, and lungs, and the bones of the extremities should be carefully looked into. The diagnosis of a compound fracture of the vault depends on a careful examination of the scalp wound. This should be done under the strictest antiseptic precautions. The wound should be treated in the beginning as a scalp wound. The head should be shaved and the skin carefully sterilized, the edges of the wound trimmed and then enlarged if necessary. The examination of the skull should be made with the finger. The probe should not be used. It is a dangerous instrument in the hands of any one but an expert.

The nature of the injury will often exclude the

probability of a fracture of the base. In many cases, on the other hand, the fracture of the vault can be followed into the base. In every case the eyes, ears, and nose should be examined for extravasated blood, and the functions of the cranial nerves looked after for fear of fracture of the base.

Every scalp wound must be examined and treated with the greatest care for fear a fracture of the skull might be overlooked. Such cases are only too frequent.

One of the most common errors of diagnosis is where an old fracture of the skull is mistaken for a case of drunkenness. This is especially common in the police stations, where many intoxicated persons are taken off the streets at night. In cases resembling opium poisoning, apoplexy, sun-stroke, epilepsy, fracture of the skull must be excluded.

In order to make a positive diagnosis, the patient should be stripped, the head shaved, the scalp wound enlarged, or the fresh scar opened and the fracture sought. When there is a depression or a wound of the bone, the recognition of the fracture is easy, but on account of the fixidity of the fragments in fracture of the skull this is not always the case. When there is any doubt a trephine may be used. A fracture of the inner table will often be discovered when the outer table seems uninjured.

Every compound fracture must be assumed to be infected and, therefore, undergo mechanical sterilization. The simplest compound fracture of the vault is a linear fracture. Such a fracture should be sterilized by chiselling off the edges of the fracture so as to

expose the dura through a canal half a centimeter wide. The dura should then be depressed and the foreign substances and infection washed out. Hemorrhage of the scalp and bone edges should be completely stopped and the scalp should then be closed. If the wound has gone a day or more without surgical treatment, complete sterilization is probably impossible. In such a case drainage will probably be necessary. Drainage may be required also when there is continued oozing from the diploë. Drainage must be looked upon as undesirable, and removed as early as possible, *i. e.*, when the hemorrhage has stopped or when the infection is excluded.

Fragments of bone should be replaced after sterilization so as to cover the dura and fill any defect in the skull. The permanent removal of portions of the skull must always be avoided. It can only be countenanced when the pieces are thoroughly infected. In such cases it is desirable to fill the defect in the skull with sterilized bone plates in which the new elements of bone may find a home. The removal of lacerated or protruding brain substance is sometimes necessary. The dura should be brought together over such brain injuries and sewed with catgut or fine silk.

When hemorrhage or compression or other complications accompany compound fracture, they require special and rational treatment. (Rupture of middle meningeal artery, depressed fracture, laceration of the brain.) The late results of infection, meningitis, abscess of the brain, and epilepsy are more fully treated under these heads.

End Result of Treatment. The greater number of

cases of compound fracture of the vault go on to perfect recovery if they escape infection. The psychic symptoms, as a late result of fracture of the vault, seem to be a little more common in compound than in simple fracture. A study of these cases does not reveal much concerning the etiology of epilepsy, insanity, and pain. In cases where there is great defect of bone after fracture, the symptom of changing intracranial pressure is only rarely present. Sometimes a cerebral hernia results, requiring closure of the defect at a subsequent operation.

Complications. Compound fractures of the vault, like simple fractures, are complicated by laceration of the brain, compression from depressed bone, and compression from rupture of the meningeal artery, besides injuries in other parts of the body. Ordinary infection must be looked upon as the rule, but erysipelas as a most serious complication. All of these conditions are treated at some length, and systematically, under the several heads. Fracture of the base must not be looked upon as merely a complication of fracture of the vault, but rather as the more serious and important lesion.

The student will find in the current medical literature, especially in the surgical journals and hospital reports, a great variety of cases of compound fracture of the skull, complicated or uncomplicated. From reading and studying these cases, and comparing them with cases to be seen in the clinics, certain conclusions can be arrived at. Among these conclusions would be perhaps the following, put in the form of adages or rules:

PLATE III

A pulsating tumor of the parietal region containing cerebrospinal fluid, in a child 7 years old, who was delivered by forceps, presented a tumor in the region indicated two days later, first talked at the age of 4, suffered at considerable intervals of "terrors" during the night, and gave symptoms of compression of the brain upon pressure on the tumor. This case was exhaustively studied by Bayerthal, in Bruns' Beiträge, Bd. 7, 1891.

1. Treat every compound fracture of the vault as carefully as a scalp wound, by trimming, shaving, and primary disinfection.

2. Enlarge the scalp wound, if necessary, so as to have easy access to the bottom of the wound and the underlying fracture.

3. Elevate depressed fragments of bone and thoroughly sterilize the surface of the dura; replace the skull fragments.

4. Unite the dura, when wounded, after arresting hemorrhage and completely sterilizing.

5. Sterilize infected masses of brain tissue by mechanical removal, replace the dura, pieces of skull, and scalp.

6. Apply with strictness the rules for wound treatment, asepsis, hemostasis, and perfect coaptation to compound fractures.

7. The infected edges of compound fractures may be sterilized only by mechanical removal.

BIBLIOGRAPHY

La Fort. Gazette Hebdomadaire. 1866.

Stromeyer. Maximen der Kreigsheilkunde, p. 529.

Hutchinson. Lectures on Compression of the Brain. London Hospital Reports, Vol. IV., 1867–1868.

Von Bergman. Die chirurgische Behandlung von Hirnkrankheiten.

Macewen. Pyogenic Infective Diseases of the Brain and Spinal Cord. 1893.

FRACTURE OF THE BASE OF THE SKULL

Anatomy. The clinical division of fractures of the skull into fractures of the base and fractures of the vault, is made on account of the inaccessibility of fractures of the base, and the importance of the structures resting on it. The base of the skull is perforated for the transmission of blood-vessels and nerves by many foramina; and it is divided into three fossæ, the most important of which, from a surgical standpoint, is the middle fossa, bounded behind by the petrous portion of the temporal bone. The petrous portion of the temporal bone is excessively brittle, and stands as the key-stone of the lower arch and lateral sinus, and it transmits the facial nerve through the long, bony canal, the aqueduct of Fallopius.

Definition. Fractures of the base of the skull may be either simple or compound. The simple fractures of the base are often trifling in character and difficult of diagnosis; while compound fractures of the base are those which open into the ear, the frontal or nasal sinuses, the nose or pharynx, or connect with the outside world through the roof of the orbit or through some perforation of the scalp by a missile or a foreign body.

Etiology. Fracture of the base of the skull is usually due to indirect violence. The patient falls upon the head and the weight of the body is borne against the base by the vertebræ of the neck. Sometimes fractures of the vault extend into the base. In rarer cases the base is punctured by bayonets and sharp instruments, and by bullets. Rarer still are the question-

able fractures by contrecoup. The skull of the adult is more apt to be fractured by indirect violence than that of the infant or youth, on account of the firmer condition of the bone substance. For the same reason the firmer and more brittle bones, such as the petrosa, are more often broken than the softer bones, such as the occipital.

Course and Prognosis. In simple fracture of the base (which is probably of rare occurrence) without laceration of the brain and without rupture of the middle meningeal artery, the prognosis as to life is favorable. The patient suffers from concussion and such injury of the cranial nerves as to discover the diagnosis. When the symptoms of concussion pass away, the patient feels no inconvenience, and goes about suffering only from the paralysis or the anesthesia. In the course of a few weeks the ecchymosis, if any, has disappeared, and nothing remains except the irreparable injury of the cranial nerves. In a few cases improvement and even recovery takes place in these.

The following case illustrates such a course:

HEKTOEN, L. *Case of simple fracture of base; injury to cranial nerves; improvement.* (*N. A. Practitioner, April, 1892.*)

A. G., age 34, fell through the floor of an unfinished building. Bleeding from nose and both ears on admission. Tissues about left eye were swollen, and the eye could not be opened. The pupil of the other eye was normal. Fluid from ears very thin; mixed with serum; did not coagulate. Also had fracture of the radius in both arms. Second day after entrance facial

paralysis of right side appeared, and persisted for eleven days. The bloody discharge from the ears persisted for twelve days, when it became purely serous in character.

Two weeks after injury noticed decided impairment of hearing in left ear, persisting at the time of patient's departure from hospital, two months later.

Most cases of fracture of the base are compound fractures, opening into the ear, the nose, or the throat. The danger of infection from these cavities is very great, and increases with the displacement of the fragments, the infectious condition of the communicating cavity, and the activities (such as coughing, sneezing, blowing the nose, and motion of the body) of the patient. In such cases of slight trauma the patient recovers quickly from the symptoms of concussion. He goes about his business. He may be troubled for a day or more by the discharge of bloody fluid from the nose, throat, or ear, and be disfigured by ecchymosis about the eye. In a few cases this favorable course continues for weeks until complete recovery takes place. But as a rule symptoms of infection within the skull come on any time from the end of the first day to the end of the week.

The patient has been feeling relatively well, and is regarded as a convalescent, when suddenly he suffers a rigor, followed by rise of temperature and the onset of a low form of delirium. The patient then lies quietly in bed until the end, or he passes, after a few hours of quiet, into the terminal convulsion. A case which I observed in 1887, in the practice of Dr. Christian Fenger, illustrates this accident:

The patient was an inspector of buildings, or at least had business upon buildings in course of construction. One day in the month of January, after a heavy fall of sleet, he was found unconscious in the basement of an unfinished building, and is supposed to have fallen through the uncovered floor beams. The fall was a considerable one, and the patient a man weighing at least two hundred pounds.

Still unconscious he was placed in a patrol wagon and carried to his home, a distance of several miles. A physician was called who found no fractures or injuries of the extremities, and no evidence of injury to the head, except an extravasation of blood in the upper part of the right orbit, and a bloody discharge from the nose and right ear. In the course of a few hours consciousness returned.

On the following day he was seen by Dr. Fenger. At this time he was sitting up and showed no evidence of injury save an edema over the petrosa, a discharge of bloody fluid from the right ear, and an ecchymosis which involved the entire right orbit. The face and tongue were not paralyzed, the pupils were equally dilated and responded to light, the grasp of the hands was equal, and the patient walked with a steady gait. He complained of headache, seemed a little stupid and headstrong, and was unwilling to follow the advice of his physicians. A diagnosis of fracture of the base of the skull was made, and a very guarded prognosis given.

In spite of all instruction to the contrary, the patient insisted upon remaining out of bed, and even visited his usual places of resort in neighboring

saloons. His condition seemed actually to improve for a matter of two or three days, but in the night of the third day his physician was called to administer for a severe chill. This was followed by a high temperature, but the patient was able to dress himself in the morning, and insisted upon sitting up. He was dull and silent, speaking only when spoken to. I saw him with Dr. Fenger in the afternoon of the same day. We found him sleeping in an arm-chair, his head fallen forward on his shoulder. He could with difficulty be aroused; answered questions briefly but rationally, and at once relapsed into somnolence.

His strength was much diminished, as shown by the grip of his hands and by the effort required in rising from his chair. The temperature was above 104, but the pulse was not proportionately rapid. The pupils were equal in point of dilatation and response to light; his face presented a sodden, vacant appearance; the discharge from the ear had ceased, and the extravasation about the right orbit was subsjding. The conjunctiva of the globe, however, was ecchymotic.

Dr. Fenger made a diagnosis of meningitis due to infection through the ear or nose, and gave an absolutely unfavorable prognosis. He suggested the possibility of draining the ventricles of the brain, but did not strongly urge it. No lumbar puncture was made, nor was any other means suggested to determine the character of the infection, though Dr. Fenger had repeatedly used the aspiration needle through a trephine opening in exploring the brain for abscesses.

The patient died two days after the initial chill, in a comatose condition. Dr. Fenger made the post-

mortem and demonstrated an almost imperceptible fracture of the petrosa, extending forward seemingly through the cavernous sinus, across the wing of the sphenoid.

In many cases of fracture of the base the injury is so terrible that the patient succumbs to the immediate effects of trauma before infection can take place. This is particularly the case in fractures involving the middle and posterior fossæ. The laceration of the blood-vessels results in hemorrhage and compression which soon extinguish the vital functions of the brain. Death follows in a few hours, and before the concussion has passed away.

A man was brought to the County Hospital, in the winter of 1886. He had been found lying unconscious beside a railroad track, and upon the supposition that he was drunk, had been taken to a police station in an open patrol wagon; thence to the hospital. Upon examination his clothes were found to be bloody; his temperature was sub-normal; his pulse was slow (40 to the minute); the left arm and leg were flaccid and immovable, while the right extremities responded to vigorous irritation. The left pupil was excessively dilated and did not respond to a lighted match held near it, while the right pupil, only slightly dilated, reacted tardily to light. His breathing was slow and stertorous (8 to the minute), and with the expulsion of each breath the left cheek was protruded. The nose was filled with dry clots of blood, and other clots were removed from the posterior nares. The face and head were covered with blood, and after a thorough cleansing a discharge of bloody serum was discovered

oozing from the left ear. There was no evidence of extravasation about the face, but several small bruises were found on the extremities. The patient was placed in bed, and his somewhat distended bladder relieved of a considerable quantity of urine which was free from blood and albumen. All attempts to arouse the patient proved fruitless, although he occasionally moved his left arm and leg. He was surrounded with hot water-bags and carefully covered with blankets. His ears were filled with iodoform gauze, and his nose and mouth kept as clean as possible by frequent sponging with antiseptic solutions. The coma deepened; the respirations became more difficult; a frothy mucus appeared at the nose and mouth, and extensive moist rales over the entire pulmonary area, especially behind. These symptoms gradually increased until morning, when the man died as one asphyxiated.

In cases such as the above the post mortem discovers extensive fracture in the middle and posterior fossæ, with rupture of blood-vessels, particularly the middle meningeal; very often also of the sinuses or cerebral vessels upon the side of the head opposite the paralysis, and corresponding to the injury. The fracture through the petrosa usually destroys the facial nerve, producing complete paralysis of the muscles of the face on the side of the injury; compression from hemorrhage, on the other hand, results in only a partial and sometimes unrecognizable paralysis of the opposite side of the face. This is the so-called "cross paralysis."

The paralysis, partial and progressive, of the arms and legs is due to cortical anemia following compres-

sion by extradural hemorrhage. The paralysis of the face, complete and immediate, is the result of injury to the facial nerve in the Fallopian canal.

In many instances the injuries are not confined to the skull and to the blood-vessels and nerves escaping through its foramina, but the brain itself is lacerated, or reduced to a shapeless pulp. Even under such circumstances life is not extinguished at once, and the lacerated brain becomes filled with extravasated blood.

Whatever the onset of the symptoms, many patients apparently recover, giving evidence of more or less perfect cerebration, only to show at a later period such symptoms of mental aberration that a hospital for the insane becomes of necessity the final resort. Another not infrequent termination is found in the dilatation of slightly injured blood-vessels which form aneurisms, rupture, and produce either sudden death or symptoms of compression.

Despagnet (Res. d'Ophthal., May, 1893) reports an interesting case of pulsating exophthalmia following a fracture at the base of the skull. It occurred in a woman, aged sixty, who was run over by a carriage, and was picked up unconscious, and bleeding from the left nostril and left ear. The bleeding soon stopped, but recurred profusely during the night. The patient complained constantly of severe headache at the vertex, and of a buzzing noise like a saw on the left side of the head. Six days later the eyelids became edematous on the right side, the right eye protruded, and the conjunctiva was chemotic. There was no pulsation then, but at the end of the third week it appeared at the superior internal angle, and the pres-

ence of an arterio-venous aneurism was no longer doubtful. Constant orbital compression over the closed eye by means of an elastic bandage was continued from the first, and by the end of the sixth week there was a perceptible diminution of the exophthalmia. The eye was totally blind, and eventually the cornea partially necrosed, but at the end of the ninth month the exophthalmia had disappeared, though the pulsation remained. Motility of the eye was nearly abolished. The left eye remained intact throughout.

If we classify the symptoms of fracture of the skull into general symptoms and localizing symptoms, the general symptoms are the result of hemorrhage or injury of brain substance or skull, while the localizing symptoms are due to the compression or irritation of special cortical areas, or to injury of cranial nerves. The following diagram is perhaps expressive:

SYMPTOMS OF FRACTURE OF THE SKULL

A. General symptoms.
   1. Injury, concussion, and later compression of the whole brain—slow pulse, slow respiration, stertorous breathing, complete unconsciousness, loss of reactions, falling of temperature.

B. Localizing symptoms.
   1. From cortical insufficiency—paralysis of face, arm, or leg on opposite side; dilation of pupil on same side.
   2. Injury of cranial nerves—paralysis of face on same side as injury, loss of sensation on same side; spasm of trapezius or sterno-cleido-mastoid muscles.

3. Marks or evidence of injury of the base in extravasation of blood or infiltration of air under the scalp or in the orbit.

General Symptoms.—The general symptoms of fracture of the base of the skull are in no sense definitely characteristic of this lesion, but are common to various conditions affecting cerebration and cerebral control of vital functions. Ordinarily the condition or history of the patient points to a severe traumatism; but unfortunately he may be found walking about the streets, or his condition may simulate alcoholic intoxication, or some form of mental aberration. There is probably in every case a period of concussion of the brain, but this is either past before the patient comes under observation, or it remains present to still further disguise the manifestations of the injury. The patient lies unconscious, his limbs relaxed, his pulse tardy, and his respirations slow and stertorous. All efforts to arouse him are unavailing; pins may be thrust into the extremities without eliciting more than spinal reflexes. The bladder soon becomes over-distended, and if neglected long enough, the urine dribbles away without control. The bowels fail to move, and there is apparent constipation. During the first few hours after injury the temperature falls, but occasionally it remains unexplainably high, due perhaps to enzyme intoxication, to fermentation within the intestinal tract, or to some unknown injury to the brain itself.

It sometimes happens after the period of concussion has passed away, that the patient, though still exhibiting some signs of mental cloudiness, rises and goes about his business; or again, he may show marked

irrationality, and be treated by the police and even by careless physicians as one drunk. If this condition persists for a considerable time, and the localizing symptoms are slight, he may through like error be sent to an insane asylum.

Localizing Symptoms. In determining the locality of an injury inside the skull, we have two sets of symptoms, due to

1. The injury of cranial nerves.
2. Compression upon the cortex.
   a. Manifested by paralysis upon the opposite side of the body, or by other definite localizing symptoms.
   b. Manifested by diminished cerebration, or more advanced impairment of the functions of the brain.

Much work has been done in mapping out the motor areas of the brain, and this subject is worth careful study. At present it is only necessary to refer to such symptoms as are likely to be useful in the diagnosis of intracranial injuries. The following areas must constantly be kept in mind:

1. The fissure of Rolando, extending from a point .5 cm. behind the mid-saggital point, to a point one inch above and one and a half inches in front of the external auditory meatus.
2. The fissure of Sylvius, extending from the bottom of the arch of the zygoma, in a line almost parallel with the base of the skull, to a point one and one-half inches behind the meatus, and one inch above it.

In regard to the motor areas, the following is certainly fixed:

1. The motor area in man appears to lie in the neighborhood of the convolutions surrounding the fissure of Rolando.
2. Generally speaking the leg center occupies the highest part of this area, the arm center the middle, and the face and tongue center the lowest portion next to the fissure of Sylvius.

The prefrontal region in man is that portion which lies in front of the motor areas above described, and this region does not seem to have any motor function; but when it is extensively destroyed in early life the patient's mental capacity remains undeveloped. When destruction of this region takes place late in life the patient loses those higher qualities which distinguish man from animals.

Word deafness is a condition which results from cortical injury, but no absolute locality has yet been fixed upon.

The cortical visual center seems to be located in the occipital lobes alone, but this cannot be used in the diagnosis of many cases of injury.

INJURY OF CRANIAL NERVES

Injuries to the roots of the cranial nerves as they pass out of the skull, or through the foramina in the bone, as in the petrosa, are of the greatest interest, not only on account of the importance of their destroyed function, but because of the value of the resulting symptoms in diagnosing and locating the injury. They are very often injured in fractures of the base. This injury is sometimes slight, a simple pressure or squeezing only temporarily interrupting

the activity of the nerve. In other cases the motion of the fragments of the bone cuts the nerve off completely and obliterates the foramen permanently. The same results are produced by saber thrusts and gunshot wounds, and by other small injuries from without. In exceptional cases a cranial nerve has been torn or completely severed without any fracture of the skull, just as the middle meningeal and the pial arteries are ruptured by the vibrations of the skull and brain in severe concussions.

The paralysis or loss of function of an injured cranial nerve sometimes comes on quite a long time after the injury and progresses (ascending and descending neuritis). It is often observed in meningitis of the base.

It is not often that a single nerve is injured except in punctured wounds of the base. In fracture of the base the trauma is so extensive as to injure several nerves and produce other even overshadowing lesions.

The prognosis of the injuries of cranial nerves depends on the extent of the injury. As a rule there is no recovery. Function completely lost is never regained. Slight impairment of function, as from compression or hemorrhage about the root of the nerve, recovers completely.

While the diagnostic value of paralysis and loss of function is almost entirely confined to the 3d, 4th, 5th, 6th, and 7th pairs of nerves, it is still worth while to consider separately injury to each of the 12 pairs in order and systematically.

I. The olfactory groove supports the bulb of the olfactory nerve, and is perforated by three rows of

orifices for the filaments, which pass down into the nose; and in front of this lies the slit-like opening for the transmission of the nasal branch of the ophthalmic nerve. On the outer side of each olfactory groove are the internal openings of the anterior and posterior ethmoidal foramina. The former transmits the ethmoidal artery and the nasal nerve. Farther back in the middle line the ethmoidal spine forms a part of the longitudinal groove, which supports the olfactory nerve. The olfactory nerve itself differs in structure from other nerves in being soft and pulpy and containing gray matter in its interior.

Injury of the olfactory nerve is of little diagnostic value. This is due to the fact that the patient is not usually in a condition to say that he has lost the sense of smell. One and both olfactory nerves have been destroyed by thrust wounds, gunshot wounds, and blows at the root of the nose, as well as by fractures of the base of the skull. The nerve is also destroyed by an effusion of blood in its sheath, and from an effusion under the dura which raises it out of its place and tears the filaments from the bone. (Henle.) The olfactory is rarely injured alone, except by thrust wounds.

Hewitt mentions several cases in which the olfactory nerve has been injured or destroyed by fracture of the base, even when the cases did not present other evidences of fracture. In one case a gentleman met with an injury of the head, which deprived him of the sense of smell for a long time. There was no injury to the nose, and smell returned after a year. In another case the loss of smell was permanent.

(Medico-Chirurgical transactions, V. 14, pages 365-421.) In another case, which seems to be original with Hewitt, in which there was a loss of smell, coincident with paralysis of the left side of the face as the result of injury, a deformity of the nasal septum was found to be the cause of loss of smell.

II. In the middle line of the skull is the optic groove, which supports the optic commissure, which on dividing passes outward into the orbit through the optic foramen, accompanied by the ophthalmic artery. As each nerve passes through the corresponding optic foramen, it receives a sheath from the dura mater, and as it enters the orbit this sheath subdivides into layers, one of which becomes continuous with the periosteum of the orbit. The other forms a sheath for the nerve, and surrounds it as far as the sclerotic. The nerve passes through the cavity of the orbit and spreads out into the retina. The ophthalmic artery arises from the internal carotid just as that vessel is emerging from the cavernous sinus, and it enters the orbit through the optic foramen, below and on the outer side of the optic nerve. It then passes across the nerve, perforating its sheath, and follows the border of the superior oblique muscle to the inner angle of the eye, where it divides into two branches, the frontal and the nasal.

Injury of the optic is of much more interest to the ophthalmologist than it is to the surgeon. Its injury is of little diagnostic value. The patient is not able to show that he is blind when he comes into the hands of the surgeon. The literature of injuries of this nerve is very extensive. It goes back to the earliest

times. Heister observed blindness resulting from injury to the nerves without injury to the bulbs.

The nerve is injured in thrust and gunshot wounds of the orbital region, and fractures of the base extending into the optic foramina. In the latter case it is usually accompanied by injuries of other nerves. In eighty-six fractures of the base of the skull, the optic canal was involved in fifty-three. The injury of the nerve varies between complete rupture by spicula of bone to simple contusion and hemorrhage within the sheath. The nerve is sometimes compressed by the displaced bone with little or very slight contusion. The injury to the nerve is not always confined to that portion which traverses the foramen. The chiasma has suffered similarly. In any case the ophthalmoscopic findings are not significant at first, and the patient cannot be relied upon to give information. Other nerves are usually injured at the same time. The connective tissue in the orbit is soon stained with extravasated blood.

On account of its close attachment to the optic foramen, the optic nerve may be torn across, not only by direct violence, but by fractures of the base of the skull, involving the optic foramen, or the optic groove. Hewitt mentions several cases of this kind. In the case of a child, whose head was run over by a cab-wheel, the optic nerve was completely torn through by a fragment of the roof of the orbit; and a patient who had been run over by a cart, besides other injuries, was made totally blind by compression of the optic commissure, through a fracture of the sphenoid bone, as was demonstrated by subsequent postmortem. He

also reports a most interesting specimen in the museum of St. George's Hospital, in which extravasation into the sheath of the optic nerve, resulting in compression and blindness, was the result of fracture of the base.

III. On each side of the sella turcica is the cavernous groove. It is broad, shallow, and curved somewhat like the italic letter *f*. This groove lodges the cavernous sinus, the internal carotid artery, and the nerve of the orbit. The foramen lacerum anterius or the sphenoidal fissure, formed by the two wings of the sphenoid, the body of the sphenoid, and the orbital plate of the frontal bone, transmits to the orbit the third nerve, the fourth nerve, and the three branches of the ophthalmic division of the fifth, the sixth nerve, and the ophthalmic vein. The foramen rotundum transmits the second division of the fifth, or the superior maxillary nerve, and the foramen ovale transmits the third division of the fifth nerve or the inferior maxillary nerve, the small meningeal artery, and the petrosal nerve. On the outer margin of the foramen ovale is the foramen spinosum, *which transmits the middle meningeal artery*. The third nerve supplies all the muscles of the orbit except two: the superior oblique, which is supplied by the fourth nerve, and the external rectus, which is supplied by the sixth nerve. This nerve pierces the dura mater on the outer side of the clinoid process, and it passes along the outer wall of the cavernous sinus above the other

53. Hewitt's case of extravasation of blood into the sheath of the optic nerve. (Holmes' System of Surgery, Vol. II., p. 332, 2d Edition, 1870.)

orbital nerves. It then divides into two branches, which enter the orbit through the sphenoidal fissure. The superior division, the smaller, supplies the superior rectus and the levator palpebræ muscles. On account of its close connections with a large extent of the base of the skull the *third nerve is more liable to injury than the fourth*, and the symptom which is produced by its paralysis, namely, ptosis, is one readily recognized. Broadie (Loc. Cit., page 351) states that he has known a ptosis of the left upper lid connected with pressure on the inferior surface of the left hemisphere of the cerebrum. The pressure was so situated as to affect the nerve immediately behind the left cavernous sinus. Sometimes all the branches of the third nerve are paralyzed. It is curious to observe how much more frequently paralysis of a single branch appears.

The third nerve is rarely injured by direct thrusts or puncture of the base through the orbit. It is very often injured in fractures of the base and its paralysis is one of the most valuable diagnostic signs. It is sometimes paralyzed by extensive extravasation at the base from the rupture of a meningeal artery and from pressure of an aneurism in the carotid sinus. Dilation of the pupil and ptosis usually appear together, but in some cases only one symptom is present, indicating the partial injury of the nerve. Injury of this nerve is usually accompanied by injury of other nerves, especially the facial.

Hewitt gives the following case:

A gentleman fell from his horse and received a severe contusion of the head. He was taken home suffering from symptoms of compression of the brain.

When several days had elapsed and these symptoms had somewhat subsided, the pupil of the right eye was found dilated and incapable of contraction. There was ptosis of the right lid and a numbness of the right hand. (Med.-Chir. trans. V. 14, page 354.) Hewitt also mentions another case in which dilation of the pupil and impairment of sight and ptosis appeared *four weeks* after injury, and gradually wore off during thirteen months.

IV. The fourth nerve, the smallest of the cranial nerves, supplies the *superior oblique muscle alone.* It leaves the skull through the sphenoidal fissure in its highest point. It is not infrequently blended with the ophthalmic division of the fifth nerve. Perhaps on account of the difficulty of recognizing a paralysis of the superior oblique muscle, very few records of injury of this nerve are to be found in the literature. Hewitt does not mention any.

Blaschek (Beiträge zur Augen Heilkunde, V. 44, p. 25) describes a case of a man, aged 52, who fell four feet from a ladder. He was unconscious for an hour; he vomited; the wound over the left parietal protuberance healed in a few days. The day after the injury he had diplopia on looking downward. The position of the head, the double vision, and all other symptoms indicated paralysis of both trochlear nerves. It was considered a fascicular paralysis due to hemorrhage in the velum medullare anterius, where both fourth nerves cross and are therefore nearest together.

V. The fifth nerve is the largest of the cranial nerves and has a mixed function. The three divisions are the ophthalmic, which enters the orbit through the

sphenoidal fissure, and the superior and inferior maxillary nerves. When this nerve is injured before its division, all of its branches are affected, but it must be remembered that each one of them may be compressed or injured and give rise to its own particular group of symptoms. The ophthalmic division is the smallest and is a sensory nerve. It appears as a flattened cord closely adherent to the dura mater and the wall of its canal. After a course of 1 cm. it divides into three branches, which severally enter the sphenoidal fissure; the frontal branch rising highest, the nasal branch being the lowest and most internal. It (the nasal branch) enters the ethmoid bone and reenters the skull only to leave by the slit before mentioned in the anterior part of the cribriform plate. It is distributed to the mucosa of the septum, to the mucosa of the atrium, and to the skin of the ridge of the nose as far as its tip. The superior maxillary division of the fifth nerve is also a nerve of sensation, and passes forward in a canal of the dura mater through the foramen rotundum. It is distributed to the skin of the alæ of the nose and the upper lip and face. The inferior maxillary nerve is the largest division of the fifth and carries with it all the motor portion. It passes outward and downward through the foramen ovale, in which the motor fibers having been separate and lying under the sensory fibers now become intimately mixed in a plexiform manner known as the plexus of Santorini. It is distributed to the teeth and gums of the lower jaw, to the skin of the temple and external ear, to the lower part of the face and lower lip, to the muscles of mastication, and it also gives a nerve of special sense to the

tongue. Affections of the fifth nerve are not at all uncommon, and instances can be obtained in almost any series of fracture of the base. One of the most important symptoms lies in the loss of taste in the anterior portion of the tongue, and in the trophic disturbances of the cornea and the skin of the face.

Paralysis of the fifth nerve is rarely an isolated symptom of injury of the base. Facial anesthesia is usually accompanied by other symptoms of fracture of the base, especially by paralysis of the third, sixth and seventh nerves. One of the most constant symptoms of destruction of function in this nerve is the ulceration of the cornea, known as keratitis neuroparalytica. In a few cases herpes appear over the distribution of the nerve. The symptoms remind one of herpes facialis devoid of the pain.

VI. The sixth nerve supplies the external rectus muscle alone. It passes from its origin in the base of the brain in a groove beneath the posterior clinoid process, where it pierces the dura mater. It passes forward through the cavernous sinus lying on the outer side of the internal carotid artery. It enters the orbit through the sphenoidal fissure and lies above the ophthalmic vein. It then passes through the two heads of the right external rectus and is distributed to the ocular surface of that muscle. This nerve is composed of about two thousand large fibers, and is distributed to a muscle which contains about five thousand fibers. Paralysis from injury of this nerve is readily recognized in internal strabismus. It is in such close contact with the base of the skull over so large an area that its slender threads are frequently torn or injured.

Many cases of this kind are to be found in the literature. While it is frequently injured in connection with other nerves, it is sometimes the only nerve involved, and its paralysis is the only symptom of fracture of the base.

Hewitt quotes the following case from the transactions of the Medico-Chirurgical Society, V. 28, page 373. A man fell from a height and lighted on his face. He never lost his senses, and merely felt shaken up. He walked home, and went to work the next day. Four days afterwards, however, he began to suffer from head symptoms, and three weeks from that time his right eye was noticeably drawn inwards. He went on from bad to worse, and died in four months. A fracture was found running across the petrous portion of the temporal bone, opposite which the sixth nerve was snapped asunder.

Von Schraeder collected fifty-eight cases of paralysis of the abducens from traumatism; in twelve isolated cases the paralysis was on one side alone, and in eight on both sides.

Van Ness mentions one case of double abducens paralysis with paralysis of the facial on one side.

VII. The seventh nerve is the most frequently injured of all the cranial nerves in fracture of the base. The facial portion is the motor nerve of all the muscles of expression in the face, and of the platysma and buccinator; it also supplies two of the muscles of the external ear. It supplies the posterior belly of the digastric and the stylohyoid; it also supplies the lingualis through the chorda tympani, and through the vidian nerve it probably supplies the levator palati and azygos

uvulæ. The facial nerve lies close to the lower border of the pons and a little inside the auditory, with which it is connected by a small fasciculus. It enters the internal auditory meatus with the auditory nerve. At the bottom of the meatus it enters and follows the Fallopian aqueduct to its termination at the stylo-mastoid foramen. On emerging from this foramen it passes forward in the substance of the parotid gland and is distributed to the muscles of the face, namely, temporal, malar, infraorbital, buccal, supramaxillary, auricular.

VIII. The auditory portion (or eighth) is a nerve of special sense, and distributed exclusively to the internal ear. It passes forward across the posterior border of the crus in company with the facial nerve. It enters the internal auditory meatus in company with the facial nerve, and is distributed to the cochlea and the semi-circular canals. It is very soft.

Of all the nerves of the face the facial is the most frequently injured in fractures of the base. Although so closely connected with the auditory, lodged in the same bony canal, one of these nerves may be injured without injury to the other, and facial paralysis appears without deafness, or deafness without injury to the muscles of the face.

Van Ness found that the facial was injured ten times among seventeen cases of nerve injury as the result of fracture of the base. The exact location of the injury can sometimes be made out by a consideration of the branches of the facial.

IX. The ninth nerve, the glosso-pharyngeal, is a mixed nerve, being a nerve of sensation to the mucous

membrane of the pharynx and tonsil, and a motor nerve to the pharyngeal muscles, and a nerve of special sense for the base of the tongue.

X. The pneumogastric.

XI. The spinal accessory.

Affections of these nerves occur but rarely in injuries of the head. They pass through the jugular foramen, which is a short bony canal, and they have abundance of room to escape pressure. Hilton (Lancet, 1853, Vol. I., page 421,) mentions an instance of fracture of the base with paralysis of some cerebral nerve. It was noticed that the patient manifested much difficulty in swallowing. The tongue was thrust over to one side. Articulation was slow and enunciation difficult, and there was pain extending down the neck on the affected side as far as the clavicle.

A grenadier (Chassaignac, Plaies de Tête, page 93) was struck in the region of the posterior superior angle of the left parietal bone by a lance, which passed deep into the substance of the brain. The lance was withdrawn a few hours afterwards, and the wound healed rapidly. The intellect was as good as it was before the injury, but the glossopharyngeal, the par vagum, the hypoglossal, spinal accessory, and suboccipital, were all paralyzed. Aphonia, dysphagia, dyspnea, with contraction of the muscles accessory to respiration—more or less paralysis of the pharynx, esophagus, and stomach, so that large doses of emetics had no effect—such were some of the most distressing symptoms presented by this poor fellow.

One more case in which these nerves became affected must be mentioned, as it shows what conse-

quences may arise by subsequent displacement of the fractured bones in an injury of the base.

A man (Lancet, 1853, Vol. I., pages 24, 25, 147) was admitted into Guy's Hospital with symptoms of concussion of the brain, and fractured base of the skull. He went on well until the tenth day, and then, after getting out of bed and walking across the ward to talk to his wife, he was seized with rigors and vomiting, and gradually fell into a semi-unconscious state. Towards evening appeared difficulty of swallowing, and the respirations became gasping. The difficulty of swallowing increased, and before the morning everything was rejected as soon as it reached the pharynx. He died of coma and asphyxia, within forty-eight hours after the setting in of serious symptoms. The brain and its membranes were healthy; there was no appearance of anything like inflammatory action; neither was the brain bruised or lacerated. A line of fracture intersecting the right foramen lacerum posterius, and running across the base, divided this part of the skull into an anterior and a posterior portion, freely movable upon each other; and the bones were so displaced that the right cerebellar fossa was lower than the left.

In commenting on this case, Mr. Hilton very justly remarks that the difficulty of swallowing and breathing, which suddenly made its appearance after the man's walk across the ward, was in all probability caused by the displacement of the bones at the foramen lacerum posterius—a displacement by which the eighth pair of nerves was irritated, if not severely pressed upon. And as there was not the slightest

trace of inflammation about the brain or its membranes, this is no doubt the right explanation of the symptoms which so suddenly made their appearance.

This view of the case is borne out by Sir C. Bell's* two cases, in which sudden death was caused by the after-displacement of fractured portions of the foramen magnum, and consequent pressure upon the medulla oblongata.

As a matter of routine the physician, in examining a case of apparent head injury, notices the appearance and position of the body, feels the pulse, notices the respirations, examines both pupils, tests the muscular and bone conditions of both arms and both legs, gets the note of resonance of both lungs, notes the temperature of the body, percusses over the bladder, and if it is apparently empty, over both flanks, and gets as much of the history as possible. In doing each of these things he acts upon the hypotheses which he forms in rapid succession that the patient may have had apoplexy or epilepsy, and in falling hurt himself; he may be sun-struck or overcome by heat; he may have over-distention or rupture of the bladder, or uremic or diabetic coma; he may have opium poisoning or alcoholism; he may have pneumonia.

While this examination is going on, the patient should be stripped and abrasions or other signs of injury looked for. The legs, abdomen, and accessible portions of the body are covered with blotches in morphine inebriates. The head, lips, and tongue are covered with scars in epileptics, and there are apt to

*On the Nervous System, 3d edit., cases cxlvi-cxlix.

be marks of burns and old injuries elsewhere on the body. In compression confined to one side of the brain, one side of the body is paralyzed; while in injury to cranial nerves, one side of the face is in spasm or in a clonic contraction.

Emphysema is sometimes the only symptom, or a prominent symptom, of fracture of the base. It is observed about the mastoid and about the ethmoid bones. The mechanism of the condition is not very complex. The mastoid is broken and one or more of the air cells are, with the interior mucous lining, ruptured. The fragments of bone tear through the periosteum and hold open the loose connective tissue under the scalp. The patient in blowing his nose or in swallowing forces air up the Eustachian tube and through the middle ear, the antrum and mastoid cells, into this loose connective tissue.

A patient that I saw with Dr. R. E. Dodge illustrated this condition. He was a powerful man, and weighed two hundred and forty pounds. He drove a large wagon. In turning out of a street-car track he was thrown from his high seat, a distance of ten feet, to an asphalt pavement. He was unconscious for several hours. When observed by me twelve hours after the injury he was semi-conscious and had been delirious. He was bleeding slightly from the left ear, and had been bleeding from the mouth and nose. There was extravasation about both eyes, but especially about the left (black eye). He had no scalp wound, but the scalp over the left mastoid was discolored by extravasated blood, and it crepitated on pressure for two or three inches above, behind, and

below the ear. There was a contused spot on the top of the head. His pulse was 60, his temperature 97, and his respirations slow and languid. He could be aroused and responded tardily, but usually rationally. His eyes moved naturally, and the pupils were equally and slightly dilated. His tongue protruded in the middle line. When he attempted to open his mouth to pronounce "o" there was a drooping toward the right side. His grip was equal in each hand, and he showed equal co-ordination when he put his index fingers on his nose with his eyes shut.

The ear was kept filled with an antiseptic dressing, and the mastoid covered by firm compression. The mouth and nose were irrigated frequently. The patient was given laxatives and kept on a liquid diet. After a few days the emphysema disappeared, the pulse became more rapid, and the slight paralysis was lost. He began to show some slight reaction, and his temperature rose to 99 and his pulse to 100. After four weeks in the hospital he returned to his home and considers himself perfectly recovered.

The rhinologists and aurists are occasionally consulted by patients who have a troublesome discharge from the nose or ear after a fall on the head. Such a case came into the office of one of my friends. The patient was a man of thirty who had received a fall from a bicycle some days before and suffered of short-lived concussion of the brain. His nose bled and he had fainting spells for a day or two after the injury, but he complained most of a dripping of serum from the nose. The fluid was found to come from the left nostril and corresponded with a black eye in sug-

gesting a fracture of the ethmoid. The nose was made clean and packed with iodoform gauze and the patient put to bed. Recovery followed in a week.

DIFFERENTIAL DIAGNOSIS OF FRACTURES OF THE SKULL

Fractures of the skull, when the scalp is not injured, must be diagnosed from the following conditions:

I. Concussion of the brain.
II. Opium poisoning.
III. Coma, diabetic or uremic.
IV. Apoplexy.
V. Alcoholism.
VI. Epilepsy.

The examiner must remember that every person whose breath smells of an alcoholic drink is not drunk. Even men who are drunk are liable to the same injuries as men who are sober, and this is especially the case with fractures of the base of the skull. Many people, in rendering aid to injured persons, pour over them the contents of whiskey bottles in attempting to bring them to consciousness.

Hardly a month passes without some newspaper report of a drunken man picked up by the police in the street and kept for twenty-four or forty-eight hours in the police station, and the eventual discovery at the County Hospital that he is suffering from a depressed fracture of the skull, a meningeal hemorrhage, or a fracture of the base.

In the stage of irritation from injury of the base it is frequently very difficult to exclude morphine poison-

ing, because the pupils are frequently contracted, the patient soporific, but capable of being aroused, and all the symptoms are bilateral. In doubtful cases the stomach should be washed out with the stomach tube even when the pupils are dilated, because atropine is frequently mixed with morphine.

In profound alcoholism the patient is nearly comatose, the extremities are practically paralyzed, and the pupils are widely dilated; the breathing in these cases is stertorous and the lips are puffed forward with each expiration, and the face is pallid and the pulse weak, as if from hemorrhage.

Fracture of the base and apoplexy are easily mistaken, especially when no history comes with the patient, and the patient is in advanced middle life or old age. It must be constantly borne in mind that young syphilitics are also liable to cerebral hemorrhage, and a close examination should be made for syphilitic scars or evidence of mercurialization.

Every unconscious person should immediately be examined to determine the condition of the bladder, and the urine should be tested for albumen and for urea. When there is a stricture, and it is impossible to pass a catheter, the bladder should be emptied with a trochar passed near the pubic bone in the middle line.

In making a diagnosis of epilepsy in an unconscious person, a broken tooth, a scar on the tongue or cheek, injuries of the lip, the forehead, or evidence of burns on the hands or face are of some diagnostic importance.

Treatment. In every case of fracture of the base, and even in cases of suspected fracture, the patient

should be put at rest and the sources of infection should be shut off as far as possible. The fractured bones of the skull should be held together in a firm skull-cap. The ears, nose, and throat should be kept as clean as possible. An antiseptic dressing may be put in the ear. The nose and throat may be washed frequently with boric acid. The patient should be kept quiet and his excretions watched and controlled. If there are open wounds they should be dressed.

When fracture of the base is accompanied by depressed fragments of bone, or by compression of the brain from hemorrhage, these conditions must be treated. In fact, the treatment of compression from hemorrhage or depressed bone furnishes the larger part of all operations in cases of fracture of the base.

FRACTURE OF THE SKULL

A. Conditions most common in fractures of the vault.
   1. Concussion of the brain.
   2. Compression of the brain from pressure of depressed bone in
      a. Complete fracture; or
      b. Incomplete fracture.
   3. Compression of the brain from hemorrhage of
      a. Middle meningeal artery.
      b. Sinuses.

B. Conditions most common in fracture of the base.
   1. Injury of the blood-vessels.
      a. Middle meningeal artery.
      b. Lateral, sigmoid, or petrosal sinuses.
      c. Ophthalmic artery.

2. Injury of nerves.
   1. Ophthalmic.
   2. Optic.
   3. Motor oculi.
   4. Patheticus or trochlear
   5. Trigeminus.
   6. Abducens.
   7. Facial.
   8. Auditory.
   9. Glossopharyngeal.
   10. Pneumogastric.
   11. Spinal Accessory.
   12. Hypoglossal.

LITERATURE ON FRACTURE OF THE SKULL

This subject has a voluminous literature. The greatest work was that of Von Bergman, Lehre von den Kopfverletzungen (1880), containing a full account of the literature up to that date, which has been followed by many valuable contributions in the surgical journals and in monographs. Every cyclopedia has interesting summaries which must be read with some reference to the time and place published—that is, with an historical criticism. In these articles, and in the sections of such pathologic text-books as Hamilton's and Zeigler's, and in the annuals, such as Sajous's, Gould's, Schmidt's Jahrbücher, and Virchow and Posner's, a very complete literature may be found. It is worth while here, however, to refer the student to the following books which will be found most useful and usually accessible.

Macewen, William. Pyogenic Infective Diseases of the Brain and Spinal Cord. Macmillan & Co. 8vo. 1893.

Phelps, Chas. Traumatic Injuries of the Brain and Its Membranes. D. Appleton & Co. 8vo. 1897.

Crile, G. W. Observations on the Surgery of the Brain. Medical Record, Feb. 17, 1900.

CHAPTER V

CEREBRAL LOCALIZATION

Only a few deductions reliable; decussation; motor areas; speech center; destroyed function never regained; prefrontal region offers no localizing symptoms; word deafness; blindness; anisocoria; tendon reflexes. Cranial topography; simpler methods the best; a simple method always available. Cerebral concussion, a little understood symptom; various grades, trifling or fatal; duration; differential diagnosis; complications; treatment. Contusion and laceration of the brain; exaggerated concussion; diagnosis impossible; prognosis; treatment, and result.

The subject of cerebral localization is discussed fully in text-books on physiology, diseases of the nervous system, and in pathologies. The surgeon is interested only in a few of the most trustworthy and absolute facts. The most reliable of these relate to the location of so-called motor cortical areas, and to the anatomy of the base of the skull. The student must have in hand the facts of cerebral localization which demonstrate the presence of a meningeal hemorrhage and the location of diseases of the brain of otic origin. I believe that the following twelve points are reliable and somewhat useful:

1. The cortical motor area of the right side of the cerebrum controls the motion of the left side of the

body, namely of the face, the arm, and the leg, and vice versa.

2. The motor areas in man lie strictly in the neighborhood of the fissure of Rolando, that for the leg above, for the face below, and for the arm in the middle.

3. The symptom known as aphasia is due to

54. Motor centers on outer aspect of cerebral hemisphere of the monkey, after Horsley and Schäfer.

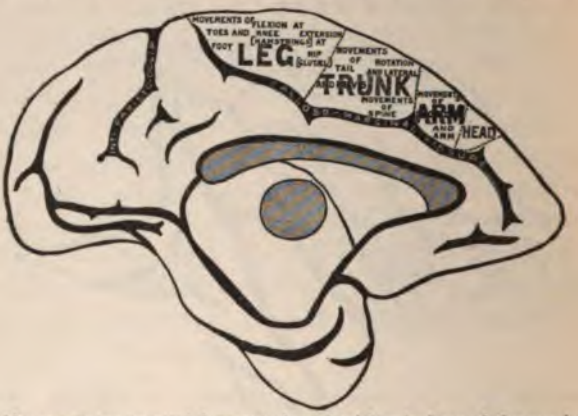
destruction of the function of the so-called speech center, which is located on the left side of the brain below the face center in Broca's convolution. (In left-handed individuals the center is probably on the opposite side.)

4. The centers controlling the smaller groups are not useful in diagnosing compression, but are suggestive in localizing tumors and abscesses.

5. The function of a destroyed center in man is not taken up by other centers as is the case in lower

animals, but the abolition of function is permanent. An apparent exception to this general rule is seen in the case of destruction of the motor center of the leg. After a time it regains a partial function, probably from the undecussated fibers.

6. There is no means at hand of definitely diag-



55. Motor centers on mesial aspect of cerebral hemisphere of the monkey, after Horsley and Schäfer.

nosing a lesion due to injury in the prefrontal region, but destruction of this portion of the brain interferes with perfect cerebration.

7. Word deafness follows injury *to* or a lesion *in* the temporo-sphenoidal lobe.

8. Blindness follows lesion of the occipital lobes, but this symptom in case of injury is more often due to injury of the optic nerve in fractures of the base.

9. The cortical center of smell seems to be in the hippocampal lobule, but it is not of diagnostic value.

10. Inequality of the pupils, anisocoria, is due in

case of compression, to general anemia of the hemisphere involved. When the pressure is great the pupil on the affected side is dilated.

11. Tendon reflexes on the paralyzed side are early exaggerated. Other reflexes are of little diagnostic value.

12. Destruction of the function of the cortex is usually preceded by a short period in which there are symptoms of irritation.

LITERATURE

The literature of cerebral localization can best be studied from the text-books of physiology, the anatomy of the brain, the text-books of diseases of the brain and nervous system, and the text-books of pathology. The student should also read the literature referred to in Hamilton's Text-book of Pathology, page 624, and to the literature referred to in Sajous's Annual, Gould's Annual, Virchow and Posner's Jahresbericht, and the Centralblatt für Neurologie for current years.

Mills, Charles K. A New Scheme of the Zones and Centers of the Human Cerebrum. Jour. Am. Med. Assn., Oct. 4, 1902.

CRANIAL TOPOGRAPHY

By cranial topography the cerebral centers are marked out on the scalp and skull. The parts of the encephalon of the greatest surgical interest are: (1) the meningeal arteries; (2) the superior longitudinal sinus; (3) the lateral sinuses; (4) the sigmoid sinuses; (5) the fissures of Rolando; (6) the fissures of Sylvius; (7) the temporo-sphenoidal lobes; and (8) the cerebellar lobes. The variation in the location of these several parts is not great enough in different individuals to give rise to error.

Methods of locating the contents of the skull are laid down by different authors in somewhat different ways, but the student must have at hand the simplest possible method. When the symptoms require that the skull be opened for injury or abscess, the following procedure will be found accurate enough, without regard to the age, sex, or size of the head.

1. The head of the patient is completely shaved and cleaned in the ordinary manner. The external auditory meatus should be cleansed and closed with an antiseptic tampon. The course of the middle meningeal artery can be laid out on the scalp with a blue pencil. Draw a line from the base of the orbit backward through the lower border of the bony external auditory meatus, and parallel with this and above it draw a line from the external angular process of the frontal bone. Measure backward from this angle an inch to an inch and a half and draw a line directly upward for the anterior meningeal artery, and draw one backward for two inches for the posterior meningeal branch. Remember that the posterior branch comes off slightly lower than this in many cases.

This spot is covered by the temporal muscle and the scalp, and a little lower down the zygomatic arch limits the depth of the practical application of the trephine. The artery lies in a deep groove on the inner side of the bone which a little higher up often becomes a tunnel.

2–4. The superior longitudinal sinus lies in the middle line on the vertex extending from the root of the nose at the foramen cecum (which is open in the

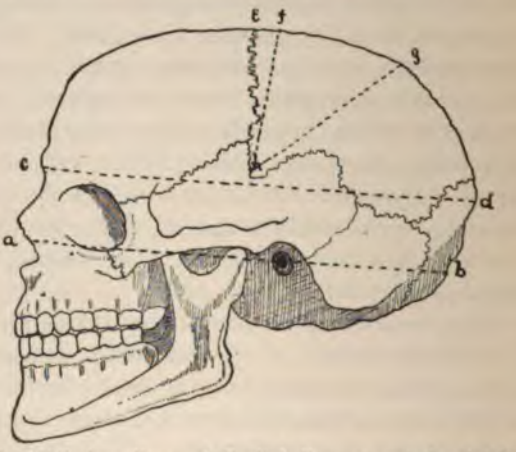
infant) to the occiput where it branches out into the two lateral sinuses. The occiput is recognized by finding the external occipital protuberance. Three lines drawn from this point, two to the mastoid processes and one over the vertex to the root of the nose, mark the longitudinal and lateral sinuses.

The width of the superior longitudinal sinus gradually increases from the glabella backward. It is two centimeters wide at the vertex and gradually widens to the torcular Herophili where it becomes a lake about three centimeters in diameter. The lateral and sigmoid sinuses are continuous. They extend from the torçular Herophili to the mastoid in a line which, on the scalp, turns slightly upward to the root of the mastoid and then swings downward and inward, marking the sigmoid portion.

5. The fissure of Rolando can be marked on the scalp with the pencil by dividing the median line extending from the inion to the glabella into two equal parts by a point, and then measuring backward from this point two centimeters. This locates the upper portion of the fissure. The direction of the fissure of Rolando can be found by applying one edge of a piece of paper cut with an angle of 67½ degrees, to the middle line of the skull, its point on the upper end of the fissure, and pointing backward. The other side will lie over the fissure of Rolando, which extends to a point which marks the beginning of the fissure of Sylvius. This paper can be made on the spot by folding a sheet of clean note-paper so as to divide one of its corners into two equal angles. Each of these angles is 45 degrees. Now, if one of these

angles is again folded so as to divide it into two equal parts, one of these parts will measure 22½ degrees, and if the outer of these two parts is clipped away with the scissors, the remaining angle will measure 45 plus 22½, equals 67½ degrees.

6. The fissure of Sylvius begins three centimeters



56. a b, Reid's base line; c d, Conlin's line; e, central point between glabella and inion; f, point 2 cm. posterior to e; f h, fissure of Rolando, making angle of 67.5°; h g, fissure of Sylvius.

behind and one and a fourth centimeters above the external angular process of the frontal bone. A line drawn from this point to the lambda passes over the line covering the fissure of Rolando and directly over the Sylvian fissure. There are some variations, the fissure being higher in children than in adults.

7. The temporo-sphenoidal lobe lies just anterior to the petrosa, and directly under the line which marks the course of the fissure of Sylvius.

8. The line marking the course of the lateral sinus also outlines the upper border of the cerebellum. It is separated from the temporo-sphenoidal lobe deeply by the tentorium cerebri. It extends to the middle line and the foramen magnum.

CEREBRAL CONCUSSION

Cerebral concussion and commotia cerebri are names given to one of the most common and least understood injuries to the brain. It is comparable to a concussion which may be received by any or all of the other parts of the body. It is, from a clinical standpoint, a series of phenomena occurring immediately or after a short interval as a result of a mechanical shaking or jarring movement. In its least serious condition the symptoms terminate quickly and no pathologic examination can be made. It is probable that the lesions are trifling and rapidly repaired. When concussion has been produced in animals and they have recovered, the closest pathologic examination has failed to reveal any adequate cause. Concussion, however, appears as a more serious injury, and it then shows more or less considerable lesions, even extending to laceration of the brain. Concussion may be said to present itself in three grades, which have been designated the mild, the severe, and the fatal forms. In the first case the unconsciousness lasts but a few moments, and there are no marked changes in the pulse, respiration, or temperature, and no symptoms following return to consciousness. In the second stage of concussion the complexus of symptoms is various. The patient is unconscious. His respiration is slow, the heart is

beating faintly, and all the evidences of great depression are present. This may last for hours or even days. The temperature may be below normal and then at last rise, possibly from auto-intoxication. Rarely the concussion produces violent paroxysms, contraction of the muscles over the whole body; the patient being apparently in a fit, with complete absence of respiration and unrecognizable pulse and heart-beat, and the face turgid, with all the evidences of impending death. This lasts only a few moments and either coma or consciousness comes on. The other form of concussion is one in which death occurs either immediately or after many hours. In the former case the examination may show no injury to the brain substance or it may show the most terrible laceration. In the latter case the laceration and injury to the brain is usually marked.

Concussion of the brain is likely to be mistaken for intoxication; for uremic, diabetic, or epileptic coma; for morphine or other forms of poisoning; for apoplexy; for suppuration within the cranium; and when protracted, with a history of injury, for compression of the brain.

When the patient is found unconscious upon the street or in other surroundings, his dress, or the findings in or about the clothes, will often suggest the probable cause of the coma. Thus, if the patient is a man of suggestive attire, and the time of day appropriate, an hypothesis of a dead drunk might be made and suitable examination undertaken. The patient should not be breathing too slowly, his pupils should not be violently contracted, his extremities

should be cold, and his heart action vigorous. Alcoholic coma is one from which the patient may be aroused by vigorous shaking.

If the patient is well attired and shows no evidence of alcohol or morphine, and is not too far advanced beyond middle life, the presumption would be rather toward epileptic coma or suicidal poisoning. The scalp and face should be examined for scars, the lips and tongue for wounds and scars, and the extremities for evidence of burns so common on the habitual epileptic. In case all of these signs are absent the pulse, respiration, or the condition of the pupil, may suggest the sort of poisoning, and the mouth may be searched for some clue, burn, or odor.

If the patient is dressed like a chronic invalid, and if he is in suitable surroundings, and if he has the appearance of a diabetic or a possible sufferer from chronic Bright's disease, diabetic, or uremic coma may be hypothecated, and the characteristic odor sought in the breath, or the urine drawn with a catheter and examined for evidence of disease.

In case any poisoning is suspected, the stomach should immediately be washed out and the residue saved, and where opium or other alkaloidal poisoning is suspected, the stomach should be filled at once with some such reagent as a dilute solution of permanganate of potassium, or with a stimulant.

If the patient has a rapid pulse and high fever, the ears, the abdomen, and the pelvis should be examined for any suppuration which might have ruptured into one of the serous cavities and given rise to collapse. Long-lasting coma frequently appears in men-

ingitis, or sinus thrombosis the result of middle ear disease.

When none of these sources of the coma are found, and there are surroundings which would be consistent with an injury of the head, the case may be considered one of concussion of the brain, and in the course of a few hours recovery from this coma may be looked for. The greatest danger in diagnosis arises when the patient is known to have suffered from a severe injury to the head, and when this injury was followed by well-recognized concussion of the brain and the symptoms pass over into those of general cerebral compression without Paget's "symptom free period." By a study of the cases of concussion of the brain as recorded in the literature it will be found that many observers have made this mistake, and have recorded deaths from concussion which were really cases of death from compression following concussion.

As an illustration of concussion, perhaps no better case can be found than the following, which occurred under my own observation:

Injury in the left temporal region; concussion of the brain of a half-hour's duration; no subsequent symptoms.

D. S., 21 years of age, was an ardent base-ball player during his high-school course, and when admitted to the university, took his place among the candidates for the varsity team. He was strong, well built, though rather phlegmatic, but he had gained a reputation for good playing. He was at the bat when a very swift curved ball struck him in the right temple. He fell to the ground, and appeared for a

moment absolutely lifeless, became blue and turgid, began to breathe slowly and stertorously, and frothed at the mouth. He assumed the opisthotonos position, with eyes open and protruding, had a number of convulsion-like seizures, and seemed about to expire. The face, however became less turgid, the breathing less stertorous, the convulsions less pronounced, and in an hour he had regained consciousness. When assured that he was all right it was possible to raise him up to his feet and walk him to his room. He was treated by application of cold to the head and a mild laxative, and on the third or fourth day he was removed to his home, where he was kept in bed for four weeks, after which he gradually resumed his active life.

From the standpoint of the physician concussion of the brain must be thought of in relation to its many complications. Even after concussion has passed off, a very guarded prognosis must be made. Although most cases of concussion are followed by complete recovery, some without much regard to the apparent severity of the injury are followed by disturbing and even serious symptoms. Among these may be mentioned: First, pain and disturbances of the circulation within the skull. Second, psychical symptoms, which may be thought of as those appearing at once and those appearing a long time after the injury. The most common followings of concussion of the brain are headache and hebetude, which are brought on for the most part by anything which would raise the blood pressure. As illustrating this complication, I wish to record the following observation in my own practice:

Concussion of the brain in a foot-ball scrimmage; consciousness after a half-hour; a second concussion of about equal intensity a week later; headache, hebetude, and sleeplessness lasting several weeks; complete recovery.

C. S., 23 years old, of fine physical development, and an excellent family history, was injured in a foot-ball game in the middle of October, and remained unconscious with concussion of the brain for about half an hour. When he came to, he was eager to go back on the field, and shed some tears when prevented. He was taken to his bath and dressed, and remained on his feet the rest of the afternoon. He played in practice games without any disturbance or inconvenience during the following week. A week after the first injury he received a similar injury to the head and lay unconscious for a little less than a half-hour, and waked up in an hysterical crying fit. He showed some symptoms of opisthotonos after this injury, and the cervical vertebræ were carefully examined. During the three or four days following this second injury he was kept in bed on account of the severe headache, with cold cloths to his head. His pupils were equally dilated, his pulse was in the neighborhood of 56, and his respirations slow and superficial. His tongue became coated, and he was almost sleepless. There were no focal symptoms of any kind. The grip was equal with each hand. The face seemed perfectly equilateral. There was no ptosis, and the pupils, though reacting slowly to light, were equally dilated. On examining the retina there were some evidences of choked disc, which was observed for some ten days

after the injury. It disappeared in the course of the week following. Headache, hebetude, sleeplessness, were increased by muscular activity. The patient was treated by vigorous laxatives to reduce the blood pressure, and kept on a very restricted diet. Recovery was complete. The pulse rose, and the pupils became normal, and the gloom and melancholy which shrouded his intellect disappeared after three or four weeks, and in the course of two months he was able to return to his studies.

Psychical symptoms follow concussion sometimes immediately and sometimes after a few hours. Cases are recorded where concussion manifested itself by aberration of the intellect instead of by unconsciousness. In other words, one is knocked silly. After receiving an injury he may begin a strange course of conduct. At other times the aberration shows itself a few hours after the unconsciousness of concussion has passed off, as if due to the reaction. Such a case is that recorded on page 91, where a father got his children up in the night and sent them to school. In other cases the concussion is followed in the course of weeks or months or years by epilepsy, or a cloud remains over the intellect which gradually deepens into actual insanity. Such a case is the following which came under my own observation:

Fracture of the skull in a child three years old; symptoms of concussion of the brain and evident compression; operation and elevation of the skull within six hours; complete recovery from the operation; the development of a child of peculiar and stupid intellect.

A child three years old fell from a three-story win-

dow and struck upon a sharp corner, making a compound depressed fracture of the skull which remained depressed when observed a few hours after the injury. The head was shaved, the skull made clean, and without an anesthetic the edges of the skull along the fracture were trimmed with a chisel and a sharp cartilage knife. The fragments were elevated, and the dura, which was uninjured, examined and made clean. The scalp was returned to its place and sewed up, and a large antiseptic dressing put on under a plaster of Paris skull-cap.

During the following day the patient returned to consciousness and the pulse and temperature became about normal. The child ate and drank, and sat up and passed on very soon to an apparently complete recovery. The wound was dressed a week after the operation. Complete union had taken place. Ten years after the operation the patient had a well-shaped head, with the scar of the operation both in the scalp and on the skull almost obliterated. The patient was, however, very peculiar in her conduct, and she had never been able to go to school or to learn to read or write. The clouding of the intellect seemed to have come on three or four years after the operation, and it appears to be increasing from year to year.

Many analogous cases can be found in the literature of surgery.

CONTUSION AND LACERATION OF THE BRAIN

Contusion and laceration occur even when there is no fracture of the skull, and also when the concussion is not severe enough to produce death. The proba-

bility is that there is no concussion of the brain without some contusion or laceration. These terms are applied to such intracranial injuries as are recognized by the naked eye in the latter case, and by microscopic examination in the former. There is, of course, no distinct line to be drawn between the two grades of injury. They are only of theoretical importance. Practically there is no way of recognizing the grade of intracranial injury during life. The symptoms which show themselves in the mildest form of contusion of the brain are often more severe than those which show themselves in rather severe grades of laceration, and they do not differ materially from them in character. The greatest importance which attaches to contusion and laceration of the brain relates to the prognosis. When a patient is injured and has a severe concussion the physician must consider the possibility of almost any grade of cerebral contusion and laceration, and he must remember that a laceration may appear harmless and trifling for weeks, months, or years, and then initiate a process of sclerosis which will involve the whole nervous system and result either in epileptiform convulsions, or in a clouded intellect, or in an impairment of some one of the special senses.

After the evidence of contusion and laceration of the brain have shown themselves in one or more of the above symptoms there is rarely anything which medicine or surgery offers for repair or relief. The removal of scars and cicatrices for epilepsy is discussed in a subsequent chapter. The physician can possibly diminish the amount of scar tissue in laceration of the

brain in much the same way as he is able to diminish the amount of callus about a fracture, namely, by securing the greatest possible rest to the part, and the most perfect nutritive and excretory functions in the patient. Otherwise he is helpless.

CHAPTER VI

COMPRESSION OF THE BRAIN

Compression of the brain by depressed fracture; diagnosis; partial depression; indications for treatment. Rupture of middle meningeal artery: Occurrence; anatomy; etiology; physics; course; symptoms; prognosis; diagnosis; differential diagnosis; treatment; methods of operating; adages. Contusion of the brain. Compression from rupture of the dural sinuses.

COMPRESSION OF THE BRAIN DUE TO DEPRESSED FRACTURES OF THE SKULL

There are two principal causes of compression of the brain in cases of simple fracture of the skull. The first is due to pressure from depressed fragments of the skull, and the second is compression of the brain from an effusion of blood between the dura and the skull, or between the dura and the pia, as a result of hemorrhage from the middle meningeal artery or other blood-vessel.

Compression from depressed fractures of the skull should be recognized by finding deformities of the skull under contusions or lacerations of the scalp; or they should be recognized by localizing brain symptoms. It must be remembered that the outer table is very flexible, and that the inner table is very brittle. It frequently happens, therefore, that in small de-

pressed fractures of the skull the inner or vitreous table remains depressed, while in the course of a few hours the outer or elastic table comes gradually back into place. It must also be remembered that occasionally there are congenital depressions of the skull and other similar irregularities which might in an unconscious person be mistaken for depressed fracture.

A simple depressed fracture of the skull over the left parietal region, with symptoms general and localizing of compression of the brain; no treatment; relative recovery.

A patient, 26 years old, a Canadian, was walking down Twelfth Street late one night in 1885, when he was attacked by two highwaymen, who emerged from an alley. This history the patient gave after his recovery. He was found unconscious by the police and taken to the County Hospital. Letters were found on him showing that his name was John D. He was comatose, cold, temperature in the rectum 97 F., pulse 60, respirations slow and irregular. Both pupils were widely dilated, the left one most widely. There was no pupillary or conjunctival reaction. He was immediately sent to the ward and his clothes were all removed. His bladder was emptied with a catheter, and eight ounces of highly colored urine, containing no albumen by the nitric acid test, were removed. There was no blood and no sign of injury to be found on his body. The stomach tube was passed, and his stomach found empty. It was carefully washed out and filled with six ounces of hot coffee. He was well wrapped up in blankets and surrounded with hot

bottles. This was about 2 A. M. In the morning his temperature had risen to normal and his pulse seemed stronger, but his breathing was short and sighing, and he was still unconscious. His conjunctival reactions now began to appear The pupil of the right eye was contracted and reacted slightly to light, but the left eye showed no reaction. There appeared to be a flattening of the right side of the face, and the right corner of the mouth hung too low. A swelling was now detected over the left ear and a little behind it. The head was shaved of all hair, and a large puffy tumor was discovered. Both ears were dry, and there was no blood in the nose or throat.

The urine was drawn with a catheter again, and two good liquid meals were given during the day with the stomach tube.

The temperature rose during the next three days to 100 F., and the patient began to throw his left arm and both legs about. His bowels were moved with an enema. On the fifth day he sat up in bed and ate his breakfast, using his left hand. He could not speak, but incoherent sounds escaped him. He heard perfectly, and seemed to understand what was said to him. When asked his name he could not reply, but tried to write, usually making a crude attempt with his left hand at a capital J, and then giving up, too weary or disgusted to continue. His right arm and the right side of the face were paralyzed.

On the tenth day the swelling of the scalp had gone down and a distinct depressed fracture of the skull, 1½ by 2 inches, could be felt. He could now use his right hand fairly well, and his face showed less

paralysis. His vocabulary now consisted of one word, "No." He could write the whole of the name John, but could not start his last name. His temperature was now normal, and he sat up. During the next month he gained his strength, went about the ward, made beds and waited on the sick patients. He recovered the phrase, "Don't know what it is," which he pronounced with a distinct Scotch accent. He remained in the hospital three months, and when he left he was a strong, well man, but he could not use fifty words. He went out to learn English again. It seems very clear to me now that this depressed fracture should have been elevated and the pressure removed at once before the brain substance under it had become atrophied. The attending surgeon asserted that all the injury was done and elevation would do no good and add the possibility, if not the danger, of infection to this case.

Seguin gave the following provisional statement of indications for trephining, which are admittedly expressed from the standpoint of the neurologist.

a. When aphasia supervenes immediately or within a few days or weeks after an injury to the anterior portion of the head on the left side, it is extremely probable that, in the first case, a clot or bony spiculum will be found compressing the speech-center; or in the second case, that an abscess has formed in or near it.

b. When simple hemiplegia or hemiplegia with hemispasm follows an injury, however slight, in the temporo-parietal region, if the paralysis or spasm be limited to one side of the face or to one extremity, the indication to operate is even stronger. Even if in

such cases the injury be not immediately over the motor area, the surgeon is justified in exploring that region.

c. In conditions of stupor and coma after cranial injuries, sometimes without external wound, in which meningeal hemorrhage is the cause of impending death, the discovery of slight hemiplegia should justify trephining, planned according to the topographical rules above laid down. In some cases latent hemiplegia may be discovered by the presence of an erythematous flush on one buttock and of a slightly increased peripheral temperature, taken between fingers or toes (?).

d. In the very rare cases in which paralytic phenomena are found on the same side as the evident cranial injury, it would seem proper to trephine on the opposite side of the skull in search of fracture or hemorrhage, the result of contrecoup.

e. In chronic epilepsy after traumatism of the head, the indication for trephining is present, but it is seldom a specific indication connected with the subject of localization. Lesions of any part of the skull and dura may be a cause of epileptic attacks, irrespective of motor centers.

Some of the contra-indications to trephining may be thus stated:

No operation should be undertaken:

a. When in apparently favorable cases there are signs of injury to the base of the brain, such as paralysis of cranial nerves, neuro-retinitis, and Cheyne-Stokes respiration, although the last symptom may occur from simple compression (?).

b. When hemispasm or hemiplegia is accompanied by hemianesthesia, thus making it probable that the lesion is deeper and farther back.

A diagnosis of injuries and compression of the brain either by depressed bone, by hemorrhage, by abscess, or by tumors, rests upon a recognition of the abolition of the function of the cortex. In order that such knowledge may be utilized, it is necessary to know the function of each part of the brain, and to have a sure means of reaching this part from the outside. Only a small portion of the cortex has so exclusive and definite a function that its destruction or compression produces single definite symptoms. This area is called the cortical motor area, and the special portions referred to are called motor centers. The motor centers of greatest diagnostic value are the face, arm, leg, head, and trunk centers. In hemorrhage from the middle meningeal artery and in compression of the brain by depressed fractures, usually more than one center is involved.

I am admittedly more positive than most teachers in recommending operation in cases of depressed fracture. It seems wholly reasonable that a depressed fracture should be elevated whenever it is recognized, whether it gives rise to symptoms or not. The fact that the fracture was sustained months before and had produced no symptoms during the interval, would constitute the only condition justifying delay; but even under such circumstances trephining would be less serious than the danger of subsequent epilepsy or other psychosis. The fact that a patient with a depressed fracture presents also a broken leg, or a

fracture of the base, ought not preclude elevating the fracture. The logical procedure is to raise every depressed fracture of the skull, provided the patient lives long enough to render the operation feasible.

COMPRESSION OF THE BRAIN DUE TO TRAUMATIC RUPTURE OF THE MIDDLE MENINGEAL ARTERY

The surgery of the brain is generally mournful and discouraging, but here comes almost the only exception. This complication or result of both simple and of compound fractures of the vault and of the base of the skull is of the greatest clinical importance. Its importance is due to the terrible danger in which the patient is placed, and to the unfailing relief which follows prompt diagnosis and rational treatment. Otherwise nearly all such patients die of what appears at first to be trifling injuries, or if they live, they suffer permanent impairment of the function of the side of the brain compressed, and what is worse, a most disastrous numbing of the intellectual faculties. It is in this respect analogous to incarcerated hernia, which demands unerring diagnosis and immediate treatment. No time can be lost.

Anatomy.—Plummer has given in the Annals of Surgery for 1896 a careful account of the anatomy of this artery. The articles of Marchand, Steiner, and Krönlein should also be read. The middle meningeal artery enters the skull through the foramen spinosum, and almost immediately divides into two branches, supplying the dura and lying in very close contact with the skull in a little trench which sometimes appears as a deep canal. It is frequently quite tortuous, and

occasionally passes through a complete bony canal or tunnel. The middle meningeal artery is the largest of the branches which supply the dura mater. It arises from the internal maxillary artery between the internal lateral ligament and the neck of the jaw, and passes upward to the foramen spinosum of the sphenoid bone. On entering the cranium it divides into two branches, the anterior and the posterior. The anterior branch, the larger, crosses the great wing of the sphenoid and reaches the groove in the anterior inferior angle of the parietal bone. It then divides into branches which spread out between the dura mater and the internal surface of the cranium. The posterior branch crosses the squamous portion of the temporal bone and on the inner surface of the parietal bone divides into branches which supply the posterior part of the dura mater and cranium. They anastomose with the arteries of the opposite side and with the anterior and posterior meningeal. On entering the cranium the middle meningeal gives off the following branches: branches to the ganglion of the fifth nerve; the petrosal branch, which enters the hiatus Fallopii, supplies the facial nerve and anastomoses with the stylomastoid branch of the posterior auricular artery; the orbital branch, which passes through the sphenoidal fissure and anastomoses with the ophthalmic artery; the temporal branches, which pass through the foramina in the great wing of the sphenoid and anastomose in the temporal fossa with the deep temporal artery. The groove becomes a tunnel in one-third of all skulls. (38 in 100 according to Steiner.) This tunneling makes a fracture through the region result

inevitably in laceration of the artery. The artery may possibly be lacerated without fracture, on account of the close relation of the sheath of the artery to the bony canal. The parietal bone where the artery is found is very thin and brittle, and has long been known by the common people as a point of danger. It is the "temple" of the old authors.

Sefton (Medical News, January 15, 1898) in the course of sixty dissections of the middle meningeal artery, found its origin in thirty-four subjects to be from the internal maxillary, in one from the external carotid, in one from the internal carotid, and in one from the ophthalmic. The anomalies were all found on the left side. The point of origin was very constant, always being between 11 and 12 mm. from the division of the external carotid. In five instances the division into the branches occurred before the skull was entered. In the fourteen cases in which the arteries were injected it was found to anastomose freely with other meningeal arteries and with the corresponding artery on the opposite side. Its size was noted in forty cases in which a plug of the injecting material was squeezed out and measured, and the vessel was found to vary between 1 and 2 mm. in diameter. The anterior branch was from ¾ to 1 mm. in diameter, and the posterior branch less than 1 mm. The artery is located in the substance of the dura mater, and surrounded by a fibrous process of that membrane. The artery may rupture without fracture of the skull, and in the case of injury the rupture may be some distance from the injury or even on the opposite side of the head.

Etiology.—The middle meningeal artery is sometimes ruptured by punctured wounds of the skull. This is, however, only a rare occurrence. Gunshot wounds give similar results. In both cases the blood usually pours out of the wound and symptoms of compression of the brain do not appear. The patient does not usually bleed to death, because the clot stops the blood in time. If, however, the wound is stopped by dressings, the blood accumulates and compression comes on.

In fracture of the vault or of the base when the fissure crosses the artery, the displacement of fragments, or the vibration of the spicula of bone severs the artery. This is the usual cause of meningeal hemorrhage. The fracture and rupture almost always occur on the side where the blow is received, but sometimes on the opposite side by contrécoup, and sometimes on both sides; on the one from direct violence, on the other by contrécoup.

When the artery is ruptured, the bleeding may take place on either side of the dura. As a matter of fact, it does usually raise the dura from the bone, and produce an extradural clot, or hematoma.

The student may comprehend the physics of an extradural hemorrhage by separately considering the following factors, namely: (1) a loosely attached dura over a considerable portion of the skull; (2) an intra-arterial pressure in the meningeal artery equal to a column of 80-100 mm. of mercury; (3) an intracranial pressure considerably less than this, probably not more than that of the jugular vein, about 9-15 mm. of mercury; (4) a large degree of compressibility of the

normal cranial contents by the exit of venous blood, of cerebro-spinal fluid, and of lymph in the brain substance; and (5) an opening in the artery.

The attachment of the dura to the skull has been shown by all anatomists, and especially by Marchand and Tillaux, to be very slight, except at the sutures of the skull, about the foramina, and at the attachment of the tentorium cerebelli. By these attachments the dura is divided into parts which, when raised from the skull by effused blood, or experimentally by the injection of fluid, form cavities holding 60-90 and even 200 cubic centimeters. All of these attachments are not equally strong, and some of them give way in the course of an extradural hemorrhage permitting all the dura, from the base of the skull to the falx cerebri and the tentorium cerebelli, to fill with one connected mass of blood.

Course, Symptoms, and Prognosis.—The course of meningeal hemorrhage is generally rapid and disastrous. The patient usually suffers from concussion of the brain from the trauma that ruptured the artery. The symptoms of this concussion pass rapidly away. They are the primitive symptoms of brain injury. Order is restored in the nervous mechanism in a moment, or in the course of a few hours at most. The circulation, the co-ordination, and the cerebration return to about their normal condition. Then an interval lapses of apparent recovery. This stage is free from symptoms. The patient rises and goes about, much himself, and makes light of the injury. This happy condition lasts only for a few hours, or in rare cases, a few days. Then the "symptom-free interval" is passed, and the

evidences of compression of the brain show themselves. These evidences have been called the "consecutive symptoms" by the older English writers. They are usually slow in their onset. The patient suffers a peculiar anxious distress, or even mental terror, with or without pain in the head. He shows imperfect judgment of his relations with those about him, or unequal perspective of common events. He is aroused to grief or mirth, fear or joy, anger or affection, without adequate cause. If his pulse and respirations are counted, they are found to slow down gradually as these symptoms proceed, the pulse going to 60 per minute, and with stupor to 40, or 30 even, and the respirations proportionately. If the patient attempts to walk or use his hands his efforts resemble those of a person under the influence of alcohol or morphine. A test of his strength will show at this time general adynamia, and a little later hemiplegia, the so-called contralateral hemiplegia. If the clot is on the left side of the brain over the speech center, partial or complete aphasia is early among the symptoms. The pupils at this time are unequally dilated, the greater dilatation being on the side of the hemorrhage. They respond to light, but more and more slowly as the anemia of the brain increases. At last the patient sinks into a stupor: he goes to sleep. This is the sleep that the common folk so universally fear after head injury. The pulse, the respirations, and the temperature of the body all gradually sink. Only with difficulty can the patient be aroused, and when this is possible, he throws one arm and one leg about, while the opposite side of the body remains powerless

and motionless. At these times the cheek or the tongue gets between the teeth and is bitten. In the further progress of the case the breathing becomes stertorous. The symptoms of edema of the lungs come on, and the pulse becomes rapid, the face turgid, and the patient dies in a complete and profound coma. Such is the end of the great majority of the cases of rupture of the middle meningeal artery, whether in simple or in compound fracture, whether in severe or in trifling injuries to the head.

In a few cases, hardly as many as one-tenth of all ruptures of this artery, the hemorrhage stops. The symptoms of compression partially subside, and the patient continues to live. These cases cannot be called recoveries. The damage done the brain is irreparable. The strength in the paralyzed side never completely returns. The psychic symptoms are often melancholy, and the intellectual impairment most deplorable. The following case furnishes some idea of the prognosis when the patient does not die at once.

Simple fracture of skull; rupture of left meningeal artery; no treatment; partial recovery.

R. M., age 67, farmer. The patient was plowing with a sulky-plow when one wheel dropped off into a ditch, throwing the patient against a lever. The lever struck him in the posterior parietal region on the left side. There was a slight depression at that place. A physician was called and a diagnosis of fracture of the external plate was made. The depression was elevated to some extent. The patient got along very well till the fifth day, when on getting up

in the morning he felt dizzy. He went out the door and fell forward on the ground. On getting up he started again, but fell and was taken into the house. The physician was called again, and diagnosed the case, "blood clot." There was a divergent strabismus and loss of motion in the right arm, and a partial loss of motion in the legs. The patient was treated with iodide of potassium and ammonium bromide. In ten days he was able to sit up. In a few more days he was dressed and out of doors taking care of the stock. At the end of eight weeks the divergent strabismus ceased. Two years after the injury the man did not walk well and was weak. He had a good appetite. (H. P. Mason.)

57. Transverse section of skull and dura mater, showing extra-dural clot at a.

If we attempt to explain the symptoms of extra-dural hemorrhage, our attention is first attracted by the "symptom-free interval." This has been noticed by all observers in the great majority of cases. It is probably due to many interacting factors. The artery does not bleed rapidly at first on account of the low arterial pressure due to concussion of the brain and the shock of the injury. When bleeding has begun, pressure on the brain is not exerted until the sinuses have been emptied of blood and until the cerebro-spinal fluid has been crowded out and the hemisphere has been forced against the bony skull and the falx cerebri. This displacement of the cranial contents,

without interfering with the circulation and function of the brain, is a sort of compensation which soon comes to an end; but so far as it goes, it is very analogous to hypertrophic compensation in cases of valvular lesion of the heart.

The localizing symptoms are due to the limitation of the hematoma by the attachments of the dura to the sutures of the skull and to the edge of the petrosa. The dura is everywhere else easily separated from the bone and is pressed down upon the underlying brain, rendering the cortex under it most anemic, and destroying its function. The amount of blood in the hematoma as determined by clinical and postmortem examination varies between 60 and 1,000 grams. Experimentally the contents of the extradural cavities near the middle meningeal is found to be from 60 to 250 grams. The amount of clot necessary to produce symptoms has been found to be greater on the vault, (300 grams,) and less at the base, (60 grams). In exceptional cases the attachments of the dura at the sutures of the skull are not sufficient to limit the hematoma, and then two or three extradural spaces are filled from a single bleeding spot.

The reason the side of the body opposite the injury is paralyzed is easily understood when it is considered that the anemia and loss of function is in the cerebral cortex, and that all the connecting nerves decussate at the base and are distributed to the side of the body opposite the motor cortex from which they arise. This is termed "contralateral hemiplegia." The anemia of the motor cortex shows itself in the beginning, sometimes by convulsive movements and cramps

in the extremities, sometimes by disturbances of sensation. Exceptionally, 7 times in 257 cases, there is said to be collateral hemiplegia. Ledderhose has collected 48 such cases from the literature where the paralysis and the hematoma were on the same side. Most observers believe all such cases are due to errors in observation. The patients are in deep coma, and even a most careful examination may be misleading. If cases of collateral hemiplegia actually occur, no one has been able to explain the symptom.

The slowing of the pulse and respiration, and the lowering of the temperature by the formation of the hematoma is easily understood. It is an anemia of the base of the brain.

The appearance of the dilated pupil is not easily explained. Experimentally it is found that pressure on the motor cortex produces at once a contraction of the pupil. Later it was believed from clinical experience that the pupils dilate, especially as the patient becomes comatose. Still many cases are observed in which contraction persists, and in one case of my own there was a congenital fixation of the iris which made this symptom misleading.

Choked disc has been observed in a few cases a number of days after the injury, but it is a rare and not a diagnostic symptom.

Paralysis of the bladder and rectum are observed in nearly all cases that survive a day or more. Spasmodic emptying of the bladder and rectum and vomiting are usually primitive symptoms of head injury, but may show themselves as the other symptoms of concussion pass off.

In rare cases there has been observed during the coma a very considerable rise of temperature. This has been explained in various ways, none of them very satisfactory. In a few cases it appears to have been due to decomposition in the intestinal tract. In others it was attributed to "nervous influences." (?)

Diagnosis.—The diagnosis of rupture of the middle meningeal artery is made by considering the following symptoms and conditions:

1. The patient is known to have received an injury of the head, or such an injury might have occurred under the circumstances.

2. There was a free interval between the end of the symptoms of concussion (sometimes absent) and the beginning of symptoms of compression. This free interval is sometimes absent (especially in fracture of the base), and is rarely more than a few hours in duration. (Half an hour to four hours.)

3. The symptoms of localized compression of the brain come on within a short time after the injury, and produce a consistent picture or grouping which could be due to cortical pressure, "contralateral hemiplegia."

4. The symptoms of general compression, slow pulse, slow respiration, and low temperature, follow the symptoms of local compression.

5. There is some mark on the scalp, a wound, a Pott's puffy tumor, or all these wanting, the patient was found under conditions that presuppose an injury or violence.

The most common localizing symptom is hemiplegia. One side of the face, the arm on the same

side, together with the leg, are either partially or completely paralyzed. The tongue is protruded toward the paralyzed side. The pupil on the opposite side is dilated. When asleep the patient breathes through the paralyzed side of the mouth with a puffing sound. The patient can sometimes be aroused. If the injury is over the left side, aphasia is a common and an early symptom. Certain words are lost, then whole groups of words, until at last only inarticulate sounds are uttered which confuse the patient. The grasp of the two hands and their co-ordination is markedly unequal.

Even early in the course of the hemorrhage there are symptoms of general compression of the brain. The intellect is disturbed, the pulse and respiration are slowed; but as the hemorrhage increases, symptoms of general anesthesia come on. Both pupils are dilated. The patient sinks into a stupor and can with difficulty be aroused. When he is for a moment disturbed, he throws his unparalyzed arm and leg about and utters uncertain complaints. These symptoms may advance until they have covered up all localizing symptoms. Both sides of the body are equally paralyzed. The patient is in a profound coma, and only a wound or injury can locate or suggest the site of the hemorrhage.

DIFFERENTIAL DIAGNOSIS

Middle meningeal extradural hemorrhage is likely to be mistaken for apoplexy when it occurs in old people or syphilitics. It has often been mistaken for drunkenness, opium, and atropin poisoning in wanderers in

the street. It is to be differentiated from diabetic and uremic coma, and under certain conditions, from the status epilepticus, and even insanity, as the following case clearly shows:

No history of injury; simple fracture of the skull; rupture of the middle meningeal artery; slow hemorrhage; pronounced psychic symptoms; diagnosis of insanity; death; autopsy.

Dr. Briggs reports the case of a man who, thirteen days before death, had been wandering about the streets, and was unable to give an account of himself.

No history could be obtained. There were no signs of injury. He was taken to one of the hospitals of the city, and as he had been drinking heavily, his condition was supposed to be due largely to alcoholism. He was in the hospital several days, during which time he imagined himself back at his work, and tried constantly to get out of bed. He was then transferred to the Bellevue Hospital, and was there pronounced insane. His friends had him transferred from the insane pavilion to the Bloomington Insane Hospital, where he died rather suddenly. No positive diagnosis was made, but the case was supposed to be one of paretic dementia. The attendant noticed that the man moved his right arm and both legs without difficulty, but did not move the left arm. The autopsy showed a fracture of the skull beginning about one inch above the external auditory meatus on one side, and running downward and forward. There was a large extradural clot, three and a half inches in diam-

eter and one inch thick. There was no fluid blood. The clot produced lateral compression of the temporo-sphenoidal lobe on the right side; the leg center was not involved. The only other changes found in the organs were those due to alcoholism.

On account of inadequate study and careless observation, many cases die unexpectedly, and a diagnosis is first made at the autopsy. Such cases as the following are altogether too common in hospital and private practice, and do not reflect credit upon the physicians under whose neglect they occur, nor on the profession which fails to require a higher standard of efficiency in its general corps.

Severe injury; no concussion; symptoms of intoxication; psychosis; rapid extradural hemorrhage; death; autopsy.

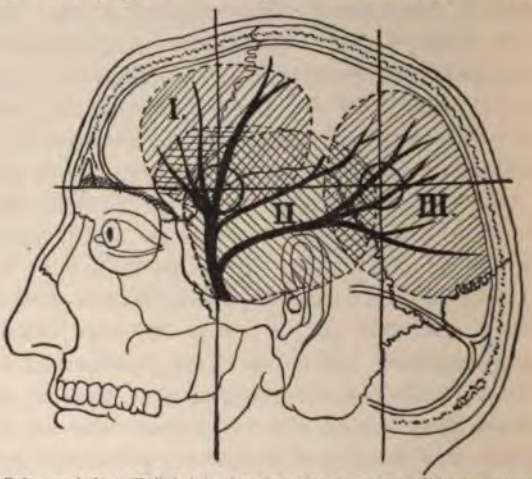
The San Francisco Receiving Hospital received, September 2, 1892, a 37-year-old civil engineer who had been knocked down by a cable car. He was dazed, but seemed to recover consciousness in a few minutes. The patrol wagon was summoned. He protested he was not hurt, and wanted to go home, but his friends thought it best to have him brought to the hospital. The assistant surgeon on duty found several abrasions and contusions above the forehead, but no certain signs of serious injury. The patient, however, presented apparent symptoms of intoxication. He had walked into the hospital with a slightly unsteady gait, talked a good deal, declared that it was nonsense to dress the abrasions on his head, took money from his pocket to pay the surgeon and steward

for their trouble, and acted as an intoxicated person might. The surgeon suspected injuries and accordingly entered the diagnosis on the books as doubtful. The man was placed in the hospital ward and kept for observation. He appeared to fall asleep at once, but never awoke. Six hours after he died. An autopsy revealed a fracture of the occipital bone. Death resulted from hemorrhage (from what vessel the reporter fails to mention) and compression of the brain. The external injuries were all in the frontal region. The occipital region showed no wound.

Treatment.—The treatment of cerebral compression from a ruptured meningeal artery is dictated by the unfavorable results which follow expectant treatment. It may be set down as an inflexible rule that every uncomplicated case of this kind should immediately be trephined, the clot and pressure removed, and the bleeding arrested. It is, perhaps, undecided what should be done when the case comes to the surgeon a long time after injury with imperfect recovery from the motor and psychic disturbances produced by the hematoma. When severe disturbances exist months after the injury, and in spite of all sorts of "alterative" treatment, the removal of the clot does little good. The brain has been so long compressed that its function is not restored by removing the pressure.

The method of removing the pressure is the only matter that requires attention. This may be dictated by the surroundings of the patient and the surgeon. The removal of the clot and the arrest of the hemorrhage should be undertaken without an hour's delay.

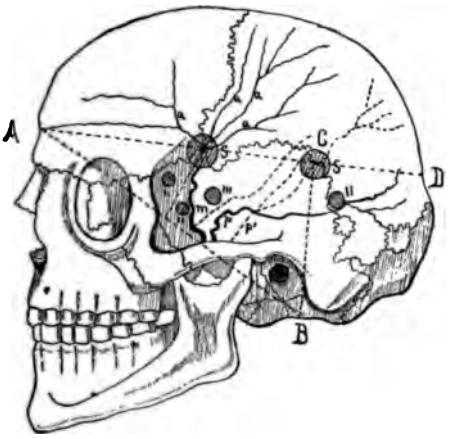
The patient's life, and if not his life, then his integrity, is in the greatest danger. The convenience of the operator should not be considered. The location of the artery is pretty uniform, and the probability that the hematoma occupies one of the three extradural spaces is very great. Diagram number 58 shows the



58. Schema (after Krönlein) showing the location of hemorrhage from middle meningeal artery, and the trephine openings by which it is approached.

location of these spaces, and the symptoms usually point out which one is involved. Hemorrhage into the middle space is the one most frequently met with; into the anterior and into the posterior less often. It will be noticed that these areas in which the hematomas are found overlap each other. The overlapping suggests the favorable points for trephining and discovery of the clot. These points are easily marked out with sufficient accuracy by the operator on the

perfectly shaved head. A tape is extended from the glabella to the tip of the mastoid and a line (A B) drawn under it. The tape is then carried horizontally around the head passing through the glabella and inion, and a second line (A C D) drawn under it. From this second line (A C D) a perpendicular is



59. Trephine openings for hemorrhage from the meningeal artery: m, anterior trunk; a, a, its branches; p, posterior trunk; p' (dotted), abnormal course of same; I., Vogt's trephine opening; II., Krönlein's two openings; III., Witherle's; S, S, Steiner's openings. (After Steiner.)

erected to the mastoid (B). It arises from Krönlein's posterior point for trephining. From the root of the zygoma a perpendicular should be erected on the first line (A B) to the second (A C D); it will meet it at Steiner's second point. When the scalp is raised this point will be more accurately determined by the junction of the frontal, parietal, and temporal bones.

Under a light anesthesia and the most careful anti-

septic precautions, a large flap of scalp should now be raised up which will contain the temporal artery in its pedicle. The bone should be stripped of its periosteum, which should be carried, untorn, back with the skin flap. The flap should be pressed sharply back with a sponge or pad of gauze in the assistant's hand. This stops all hemorrhage from the flap. Hemorrhage from the remaining cut surfaces of the scalp should be stopped by ligation or by provisional stitches such as have been previously described. The small trephine may then be applied for diagnosis. If the black clot is found, the opening should be enlarged by a larger trephine or by the DeVilbis rongeur, or other instrument. The chisel and hammer are excellent instruments for this purpose, and always at hand. The clot should then be removed by a bent wire resembling an egg-beater, or by the finger, and a stream of warm (100 F.) sterilized water. As the last bit of clot is removed, the hemorrhage usually begins again. The dura with the inclosed artery comes into view. If the rupture is now accessible, it can at once be ligated by using fine silk (No. 2) in a smooth full-curved needle, passing the thread around the artery. Both ends of the artery should be ligated. If the rupture cannot be reached through the opening already made it should further be enlarged. Even at the best the rupture is sometimes found so far toward the foramen spinosum that it cannot be ligated. In these cases it has been closed with the galvano cautery. It has been tamponed by thrusting a bit of iodoform gauze into the foramen at the tip of the finger to be withdrawn at the end of forty-eight hours. Such cases are usually accom-

panied by a fracture of the base and conditions adding infection to the dangers. When the hemorrhage is perfectly stopped from the dura and bone edges, the pieces removed should be taken from the warm salt solution in which they have been kept, and replaced. The scalp flap should be dropped over all, and the periosteum and skin carefully united throughout the full extent of the wound. If the fracture was compound, or if the operation is done under circumstances that presuppose infection, or if the hemorrhage has not been completely arrested, drainage should be made during the following twenty-four hours, or in rare cases longer. A drain must be greatly deplored, and every effort made to render it unnecessary; but when used it should be removed in twenty-four hours, if used for hemorrhage, and retained longer only for infection.

If the diagnosis of uncomplicated hemorrhage of the meningeal artery is clear before the operation is begun, or if this diagnosis can be made before the scalp has been raised from the skull, *the skull should be taken up with the attached scalp* and an osteoplastic operation made with a large flap of bone. The pedicle of this bone flap should cover the lowest portion of the meningeal artery. This is ideal trephining, if the word permits of such use.

The following case from my own clinic, while having one confusing symptom, is in most respects typical of the diagnosis, treatment, and result of treatment in cases of meningeal hemorrhage.

Blow upon left temple; no symptoms of concussion of the brain; a free interval of an hour and a half; psychic symptoms appearing first; aphasia; rapid progress; removal of the pressure three hours after injury; prompt recovery.

On April 24, 1898, McI., 24 years of age, a post-graduate student, was playing base-ball, and was at the bat. He was a tall, lithe, active fellow, and had a place on the varsity team. A swift, curved ball hit him in the left temple, about four o'clock in the afternoon, and although it stunned him for a minute, he did not fall down, and wished to resume his bat. He was sent off the field, and immediately after went with a number of small boys to the gymnasium, took off his clothes, took a shower-bath, dressed himself, and went to his room, which was on the fifth floor, not far from the gymnasium. His head ached some and he threw himself on his bed for a few minutes, when he began to suffer from a terrible mental anxiety. He went down to the second floor and told Mr., now Dr., Raycroft that he was hurt. Raycroft made an examination of him, found that he spoke with some incoherence, stumbled over a few words, and seemed to use his left hand more than his right. Raycroft put him in bed at once in a semi-recumbent position, put an ice-cap on his head, and sent for me. Being unable to attend at once, I sent Dr. Galloway with instructions to look for symptoms of compression, namely, dilatation of the pupils, paralysis of the face, arm, or leg, deviation of the tongue, a slow pulse and respiration, and a falling temperature, requesting

him to report by telephone. In the mean time I ordered an ambulance to be ready, and at 5:30 o'clock, having received a telephone message that indicated compression, I had him transported to the Baptist Hospital. The examination of the patient at the hospital showed a pulse below 40, with slow respirations, almost complete paralysis of the right arm and leg, and equal normal dilatation of both pupils, but an unexplainable condition in which neither pupil responded to light. The patient could with some difficulty be roused, incoherently crying out "Let me alone," and "get away." A diagnosis of rupture of the middle meningeal artery was made upon the following symptoms:

1. A history of a blow on the left temple (without local sign of injury at this place).

2. Brief and trifling concussion of the brain at the time of the injury.

3. A symptom-free period.

4. Aphasia, paralysis of the right arm and leg coming on an hour and a half after the injury, and gradually increasing.

5. Symptoms of general compression of the brain beginning an hour and a half to two hours after injury, consisting of a slow pulse (below 40), slow respirations (6 to 9), and loss of consciousness. The following anomalous conditions, however, made the diagnosis uncertain:

1. Both pupils were of equal size and not dilated.

2. Neither pupil responded to light.

3. There was no puffy tumor, abrasion, or other

objective evidence of injury of the head or fracture of the skull.

In spite of the relative diagnosis, I determined to trephine; had the head shaved and prepared, and made an opening through the skull and scalp so that the flap of the scalp wound should be supplied by the temporal artery, and directed so as to open the skull as near the base as possible and over the lowest portion of the middle meningeal artery.

Only a small amount of chloroform was necessary, and on turning back the bone flap, I found a black mass protruding into the opening, which proved to be a part of an enormous clot of blood which could not have been less than 600 or 800 grams in weight. This clot was removed by slightly depressing the brain and scooping it out with the finger, assisted by a stream of sterilized water. The bleeding end of the meningeal artery was then grasped with the forceps, and carefully ligated with the aid of a smooth needle. All the bleeding was stopped, the wound completely closed, and an antiseptic dressing covered by a skull-cap was applied. The operation lasted an hour and twenty-five minutes. The patient gradually came out of the anesthetic and began to talk at once. He recognized his friends, slept moderately well during the night, and on the following morning was able to read, making some slight hesitation at or completely losing every tenth word. Two days later another test was made, and he hesitated at or lost about every one hundredth word. After that time his co-ordination increased rapidly, and by the end of the week he could have been pronounced well. He resumed his

work in the university three months later, and since that time he has been conscious of no bad effect from the injury or the operation. Dr. Albert Hale examined the eyes after the patient was about and found congenital attachment of the iris to the lens. This explained the perplexing symptom.

Rupture of the left middle meningeal artery seems to be a very common accident. Three cases have come to my notice:

Roswell Park reports the following case: "A laborer about fifty years old, returning from work, slipped on the sidewalk, fell, striking on the back of his head, was stunned for a moment, helped himself up, and walked two miles to his home. Not till next day did he begin to act strangely, when he became successively restless, wandering in speech, apathetic, stupid, and comatose. On the fourth day he was sent to my clinic, when I trephined six cm. above the left ear. I found an immense extradural clot extending backwards; so large was it that through a large opening I could not remove it at all. I then made another opening in the occipital region. Finally with probes, sharp spoons, forceps, and a powerful irrigating stream, I removed a great teacupful of firm dense clot. Through and through drainage was made for two days, by which time the depressed brain rose to its proper level. The patient made a rapid and uninterrupted recovery, and was at work within a month."

Simple fracture of the skull; prolonged concussion of the brain; compression of the brain from ruptured left meningeal artery; contralateral paralysis of face, arm, and leg. Collateral paralysis of the face; aphasia; trephining on eighth day; removal of a large extradural clot; recovery.

Joseph H., a miller, 30 years old, was brought into the hospital on the night of April 9, 1885. He had suffered a fracture of the skull two days before by a fall from a ladder. No other details were brought with him to the hospital. He was a strongly made, well-built man, with a slight abrasion in the neighborhood of the left temple, and no other evidences of injury. The patient was not wholly conscious, but could with difficulty be aroused to speak. He answered questions wholly unintelligibly or not at all. The possibility of aphasia was considered, the pulse was 120, the respirations 28 to 30, and superficial. There was left-sided facial paralysis; the pupils were greatly contracted, but reacted to light. The left lower lid was edematous and stained with blood. The right arm and leg were paralyzed. Sensibility appeared to be present. Urine passed involuntarily. No vomiting, no delirium. On the following day a new symptom appeared: right facial paralysis. The pulse became irregular, 55 to 60 per minute.

Eight days after the injury the condition became decidedly worse. The patient was completely comatose and yawned frequently. Strong pressure over the left temple seemed to be painful.

At this time the following diagnosis was made:

Fracture of the base running through the left middle fossa and the left petrous portion of the temporal bone. Compression or rupture of the left facial nerve in its course through the Fallopian canal. Rupture of the left middle meningeal artery with a left-sided extradural hematoma. Compression of the arm, leg, and speech cortical centers for the right side, and the motor center for the right side of the face.

Typical trephining was done at a point one-half inch above and one inch in front of the ear, at the junction of the temporal and parietal bones. A very firm clot was removed from the extradural space and the artery was tied. The whole clot weighed about 240 grams. His recovery was very rapid. Three hours after the operation he awoke from his stupor and tried to speak, but his words were not wholly intelligible. In the morning after a restless night, during which the patient slept but little and muttered continually to himself, the condition was decidedly better. The paralysis of the right extremities had decreased. On the 16th of April the patient answered most questions distinctly and precisely, and the right facial paralysis disappeared. The pulse was 90 and the temperature normal. On the 19th of April the paralysis of the right side had completely disappeared. The speech was better, but certain syllables were wanting. On the 15th of May he left his bed. No paralysis was present. He was discharged from the hospital on the 30th of May six weeks after his injury.

The ultimate result of treatment depends upon the promptness and thoroughness with which it can be undertaken and carried out. The brain recovers com-

pletely if it has not been compressed too long. It can probably withstand for two days any compression compatible with life. If all the blood is promptly removed and the hemorrhage completely stopped, if the wound in the skull is completely closed by replacing the trephining buttons, and if there is no infection or other complications outside the injury to the skull and artery, there will invariably result complete and immediate recovery.

An imperfectly closed skull wound or one closed with suppuration, an injury to the brain or the cranial nerves coincident with the rupture of the artery, render the patient liable to the dangers which follow compound fractures and ecchymosis into the brain substance.

If the operation of removal of the hematoma and compression is delayed, the brain never entirely recovers its function. There is no case where complete absorption of the clot and complete return of the function of the brain is reported.

Although the end results of rational treatment are so good, in any particular case a guarded prognosis must be given, because it is impossible to make an exclusive diagnosis. Some unknown complication may render a favorable prognosis very embarrassing.

The complications of rupture of the middle meningeal artery, which must always be held in mind in attempting to make an exclusive diagnosis, are very numerous. (It is necessary here to consider injuries in other parts of the body.) Among the most important are:

1. Depressed fracture of the skull. The impor-

tance of this complication rests in the fact that symptoms of compression appear at once, and after a period corresponding to the free interval, they increase in severity.

2. Laceration of the brain. This is the most common of unrecognizable conditions. It is often present in cases when there are prolonged symptoms of concussion. Recoveries are not usually very perfect to these patients. The end results are especially bad.

3. Fracture of the base of the skull. In cases in which fracture of the base is present infection is apt to occur and present evidence of irreparable injury to the cranial nerves.

4. Compound fracture (infection). In cases in which the fracture is open, there is not only infection, but usually considerable laceration, or even loss of brain substance. The dura is usually open.

5. Fracture into a suppurating middle ear. This rare accident is so serious that it cannot be forgotten. Inquiry and investigation should always be made to determine the possibility so that proper treatment may be instituted.

ADAGES

1. The rupture of the middle meningeal artery is a condition of surgical importance analogous to edema of the glottis, strangulated hernia, intussusception of the bowels, rupture of the bladder or urethra, or emphysema from fracture of a rib or of the trachea, in requiring prompt diagnosis and treatment.

2. The results of expectant treatment are almost without exception disastrous to life or mental integrity.

3. No expectant treatment can be countenanced when the diagnosis is made.

4. The hematoma should be removed at once.

5. The hemorrhage should be completely stopped.

6. The opening in the skull should be closed.

7. The osteoplastic operation is the best.

8. When the blood is stopped and the wound clean, there is no occasion for drainage.

9. The scalp sutures should be removed in forty-eight hours.

LITERATURE ON RUPTURE OF THE MIDDLE MENINGEAL ARTERY

The complete literature can be found in the Index Catalogue of the Surgeon-General's Library and in the Year Books. The following articles are noticeable:

Steiner. Zur chirurgischen Anatomie der Arteria media meningea. Archiv für klinische Chirurgie, Bd. 48, 1894.

Plummer. Research on the Anatomy of the Middle Meningeal Artery. Annals of Surgery, 1896.

Krönlein. Ueber die Trephination bei Blutungen aus der Arteria meningea media und der Arteria Schadelkapsel. Deut. Zeitschr. für Chir. Bd. 23.

CONTUSION OF THE BRAIN

It is probable that in rare cases injury is done to the blood-vessels of the pia or of the cortical substance of the brain, which results in motor disturbances similar to those produced by rupture of the middle meningeal artery or of the sinuses, but less extensive. Such may be the result of either direct or indirect violence. A case of this kind is reported by Hotchkiss.

HOTCHKISS L. W. *Motor aphasia due to small cortical hemorrhage in the region of Broca's convolution; trephining; recovery.* (*Annals of Surgery, July, 1892, page 82.*)

The patient was a man 39 years old, who fell from the narrow step of a cellar stairs nine feet, striking presumably on the back of his head. He remained unconscious for eight hours. When he recovered consciousness he appeared dazed and had great difficulty in talking. He bled freely from his right ear. He was admitted to the hospital on the following day when he was able to walk. There was no paralysis noticed in either hand. He appeared dazed and troubled because he could not talk. He recognized every object presented to him, and could only answer "Yes, certainly." He could not speak his own name, but he could write the first part of it fairly well. When asked a question he would make a great struggle to answer it, and his muscles of articulation were almost in spasm, but he could not utter a word. His temperature on admission was 100, his pulse 90, and his respirations 20. The urine showed a specific gravity of 1.039 with slight traces of albumen. There was a small contusion over the right occiput. The patient was put to bed and given sodium bromide every three hours. The aphasia became complete, but the other symptoms remained the same. There was a slight temperature, and the pulse became slower, reaching 68, and the grip of the hands remained the same, though both were slightly weaker. The lower extremities were not paralyzed. The right side

of the face became somewhat flattened. The angle of the mouth on the right side was somewhat lower than on the left side. His tongue protruded toward the right side. He was able clearly to comprehend questions, but was absolutely unable to utter a single word. His efforts to speak resulted in clonic convulsions of the right side of the face and neck, accompanied by expiratory grunts. The presence of motor aphasia with the right facial palsy pointed clearly to pressure over the speech-center of the cortex, and immediate operation was done.

A half-inch conical trephine was applied about one and a half inches behind the angular process, and the same distance above the zygoma, and a button of bone removed. The dura mater appeared black, tense, and pulseless. There was no evidence of fracture of the skull in this region. The trephine opening was then enlarged forward and downward, and the field occupied by the clot exposed. The dura was opened by a careful incision and some dark fluid blood escaped. The hemorrhage seemed to have come from small cerebral arteries. The clot, which was removed with a dull instrument, was firm and moderately adherent to the cortex of the brain. Some slight oozing of red blood occurred after the removal of the clot. The cortex was slightly lacerated. The flap of dura was replaced, but not sewed down, and the wound treated in the usual way, with temporary drainage. A few hours after the operation he had a slight convulsion of the right side of the face, and in an hour a second which seemed to involve the arm and leg also. During the third, fourth, fifth, sixth, and tenth days he improved

in every particular, and especially in the use of words. On the second day after the operation he could say "yes," "sure," and "certainly." On the fourth day he used a long, complete sentence, and following this his vocabulary rapidly increased. In the few months following the operation there were no complications, and the patient rapidly gained confidence in his ability to express himself properly.

This case seems clearly to have been one of cerebral contusion, and from all that can be made out from the history, the hemorrhage was from the arteries of the cortex; but we must remember that this is the region of the middle meningeal artery which is very frequently injured, and the fact that the hemorrhage was intradural rather than extradural is not conclusive that it came from the branches of the cerebral artery.

COMPRESSION OF THE BRAIN FROM HEMORRHAGE OF THE DURAL SINUSES

Hemorrhage sometimes comes from the lateral or longitudinal sinuses. In 117 cases of intracranial hemorrhage elaborated by Chipault, 72 cases were due to rupture of the middle meningeal artery, and 30 cases to wounds of the venous sinuses. A case of this kind came into the County Hospital during my service.

A strong and healthy Irishman was driving his hansom cab down the slight incline from the Adams Street bridge when his horse fell. The shafts of the cab broke off and stuck into the pavement like a dog in a ratchet, and the cab stopped suddenly, throwing the cabman over the cab and horse in the

arc of a circle. He struck squarely on the top of his head on the frozen pavement. He was stunned by the blow, but soon came to himself and transferred his passenger to another cab and drove his own horse home, a distance of several blocks. He ate a good supper that night and went to bed feeling somewhat sore, but apparently uninjured. He awoke in the morning, but was unable to get out of bed on account of weakness of his legs, and he rapidly sunk into a stupor, from which he could with difficulty be aroused. When a physician was called to see him about noon he recommended his removal to the hospital. On admission he was able to use his left hand. There was no paralysis of the face, and he could be roused enough to speak a little. After shaving his head a puffy tumor was found running from the middle of the vertex towards the left ear. A fissure could be made out indistinctly, and the left parietal bone gave a distinct thud on percussion. A button of bone was removed a half-inch on each side of the median line so as not to open the superior longitudinal sinus. An extradural clot of blood was demonstrated covering the upper portion of each hemisphere. After removal of this, signs of a lacerated wound of the upper portion of the longitudinal sinus came into view. The trephine openings were connected by removing the overlying skull with a saw. The head of the patient was kept low, and the wound of the wall of the sinus was closed with a fine silk continuous suture. The blood was washed away, and the clot removed. The buttons of bone were replaced, and the scalp brought back with temporary drainage.

The operation had been done without an anesthetic. The patient soon awoke and three days after the operation returned to his home, greatly against the wishes of the surgeons; but he suffered no inconvenience, and I have frequently seen him driving his cab to and from the Burlington station during the past ten years.

Compression from wounds of the venous sinuses of the brain is of very rare occurrence, and is usually accompanied by other more serious injuries. In Wharton's collection of 70 cases, the superior longitudinal sinus was injured 40 times, the lateral sinuses 25 times, the cavernous 3 times, and the straight 1. von Bergmann mentions two cases of rupture of the transverse sinus, and says it is liable to rupture when the force is applied from above or behind. In Wharton's cases death occurred in 65 per cent, and the percentage of death was about the same wherever the injury occurred. It appears that the older writers considered hemorrhage from the dural sinuses as of trifling importance, and believed that these hemorrhages were unable to produce compression of the brain. In Wharton's cases, however, death resulted in seven cases from hemorrhage through an opening in the skull and scalp. Hemorrhage occurred below the dura in twenty-six fatal cases, and compression was produced by extradural clot in eleven cases. One of the complications of injury of the dural sinuses is air embolism, which is apt to occur when the wound is open or during the attempts at repair. Two such cases are reported by Genzmer and von Bergmann referred to by Wharton. This can probably be prevented by performing the

operation with the head depressed much lower than the trunk.

Wounds of the sinuses have been known to heal without obliteration of the canal, and when thrombosis occurs as a result of tamponade, and the sinus thus obliterated, it has never given rise to any interference with the functions of the brain. The one danger of thrombosis is infection from the tampon or from the external wound. The treatment is carefully discussed by Wharton, but it may be put down as dependent entirely upon the character of the injury. Suture, if it can be done, otherwise tampon.

LITERATURE

Medical and Surgical History of the War of the Rebellion. Vol. II., page 308.

Köhler, A. Zur Casuistik der Gaumenschlusse. Deutsche Zeitschrift für Chirurgie, vol. 23, 1886, p. 381. With literature.

Bardeleben. Ueber Behandlung von Verbrennungen. Deutsche Medicinische Wochenschrift, 1892, No. 23.

Stimson, L. A. A Treatise on Fractures, 1883, p. 280.

CHAPTER VII

ABSCESS OF THE BRAIN

Statistics; age distribution; source; bacterial cause; etiology. Acute traumatic abscess: Importance; frequency; anatomical forms; course; symptoms; terminations; example; diagnosis; treatment; result. Chronic traumatic abscess: Symptoms; form; examples; diagnosis; treatment. Abscess of the brain of otic origin; nasopharyngeal adenoids; circumscribed inflammation of the meatus; eczema of the meatus.

In 9,000 autopsies reported by Pitt from the statistics of the London hospitals there were 56 abscesses of the brain. Treitel reports 6,000 autopsies from the records of the Berlin Institute with 21 abscesses of the brain, or altogether one brain abscess to every 200 postmortems. This would indicate a very great frequency of abscess of the brain. The statistics for the city of Chicago for 1894 show a total of 23,892 deaths from all causes; 43 were attributed to abscess or softening of the brain (and 642 other cases to inflammation of the brain and its membranes), or 1 brain abscess to 500 deaths.

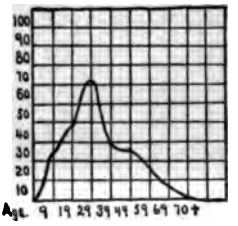
Brain abscess is more common in men than in women; of 232 cases, 174 occurred in males and 58 in females, a ratio of three to one.

No time in life from birth to old age is exempt from cerebral abscess, but the affection seems to be rare

during the first year of life. Gowers gives the following table:

1 to 9 years	24 cases.
10 to 19 years	48 cases.
20 to 29 years	72 cases.
30 to 39 years	29 cases.
40 to 49 years	26 cases.
50 to 59 years	16 cases.
60 to 69 years	7 cases.
70 years and over	1 case.

Abscesses of the brain are of various kinds, whether we look upon them from a pathologic standpoint in the laboratory, from a clinical standpoint at the bedside or operating table, or from an etiologic standpoint. In any case it is necessary to keep in mind that the only known cause of abscess of the brain is infection, and that the micro-organism has only three ways of gaining access to the brain: (1) by the infecting instrument direct; (2) by way of the blood-vessels; (3) by way of the lymph channels.



60. Curve illustrating relative frequency of brain abscess in the decades from 1 to 70 years and over, according to statistics by Gowers.

Abscess of the brain shows itself in three anatomico-clinical forms:

1. Acute, diffuse abscess of the brain.
2. Chronic, encapsulated abscess of the brain.
3. Encapsulated abscess of the brain, becoming acute.

The acute diffuse abscesses of the brain are some-

times so rapid in their onset that the walls of blood-vessels are destroyed and extravasations of blood appear in the abscess itself, thus adding the symptoms of apoplexy to those of abscess. Such rapid softening is most common in pyogenic embolism. The resulting infarct is at first anemic, then hemorrhagic, and at last it becomes an edematous mass of infected brain tissue.

The softening, however, is sometimes the result of an advancing infected thrombosis. In such cases brain tissue may be wholly free from hemorrhage and the abscess of a clear yellow color.

From a bacteriologic standpoint there are two forms of brain abscess:

1. Abscess due to pyogenic micro-organisms.
2. Abscess due to tuberculous or syphilitic infection.

In a few cases abscesses of the brain have been found to be free from all micro-organisms. It is probable that in these cases the micro-organisms had died from the action of the germicidal elements in the brain or body, or that the methods used by the investigators were not accurate. The principal micro-organisms found in brain abscesses are the pyogenic staphylococcus, the streptococcus, the diplococcus of pneumonia, the typhoid bacillus, or what seems more likely now, the bacillus coli communis.

Actinomycosis and other rare forms of infection produce abscess-like formations in the brain, but they are of little clinical importance. Quinsey found 19 cases of actinomycosis of the brain secondary to actinomycosis of the face and neck. In 6 of these cases the

brain was involved by direct extension of the disease from the primary focus, and in 10 there was metastasis.

In epidemic cerebro-spinal meningitis, cases of abscess appear which Strümpell found in 4 instances to be due to the pneumococcus.

From an etiologic and clinical standpoint abscesses of the brain are due to:

1. Direct infection of the brain with dirty instruments or gunshot wounds.

2. Infected wounds about the head.

3. Spread of infection from infected adjoining bone, the result of wounds not penetrating the skull.

4. Infection carried from diseases in the accessory sinuses of the nose and ear, or infection in glands or tissues elsewhere about the cranium, especially middle ear disease.

5. To pyemic metastatic infection of the brain, the infected material being carried through the arterial system from the heart or lungs. This is especially common in endocarditis and abscess of the lung.

For our purpose it will be well to consider abscesses of the brain of traumatic origin, both acute and chronic, and abscesses of otic origin in order; and then briefly refer to cases coming from atria less often the source of the disease.

ACUTE TRAUMATIC ABSCESS OF THE BRAIN

The history of traumatic abscesses of the brain, whether acute or chronic, belongs properly under scalp wounds, or compound fractures of the skull, or other head injuries. They have, however, been known

to follow injuries or operations on the face and head, and especially operations in the nose and on the eye. The term traumatic abscess is misleading, and it must always be understood as meaning abscess arising through infection introduced by trauma.

The frequency of acute traumatic abscess of the brain is not nearly so great as that of otic origin. Gowers's collection showed only 24 per cent of traumatic origin, while in Pitt's 56 cases, only 9 were from injury.

Acute traumatic abscess arises after injury of the scalp or of the skull, and invasion of the brain itself by the micro-organisms after the arachnoid space is obliterated. Acute abscesses usually arise in injured brain tissue or in blood clots in the cortex. The infection may be carried directly into the brain by the offending instrument. It may be carried through the lymphatics or it may travel through a vein as an infected thrombus. The abscess itself is a mass of liquid pus, or bloody pus with floating shreds of necrotic brain tissue. The abscess is surrounded by a zone of red softening, and this by an outer zone of edematous brain substance. The form of the acute abscess is irregular, and its borders ragged. They are not as a rule so well circumscribed as the more chronic traumatic abscesses or as the abscesses arising from the petrosa. Over nine-tenths of traumatic abscesses are single, but more than one abscess is sometimes seen. The inner one is only an extension of the infection from the outer abscess. Acute abscess of the brain may be coincident with meningitis of a local or general nature. It is usually preceded by some local

meningitis, and may terminate in general meningitis when an abscess opens into one of the ventricles.

Acute traumatic abscesses may be located in any part of the brain, but as a matter of fact, they are usually found near the site of the wound or fracture, and for the most part in the cortical substance of the cerebrum. This is due to the fact that most injuries of the head are in this region. In some cases, although the wound is not penetrating and directly over the cortex, this portion of the brain escapes and the abscess is found deeper in the white substance. The micro-organisms are probably carried by an infected thrombosed blood-vessel from the pia or by leucocytes through the lymph spaces, and finding an extravasation or an anemic and edematous portion of brain, they set up the destructive process.

In the beginning there is no evidence that an abscess is to be expected. The patient suffers a wound of the scalp, and perhaps symptoms of fracture of the skull. There may not be any evidence of infection in the external wound, and the physician and patient may consider that everything is doing well until the initial symptoms come on.

At the end of a week, or even two weeks, from the injury the patient complains of terrible pain in the head, usually in the forehead, radiating and boring in character. It is sometimes so terrible as to render the patient almost frantic. It is accompanied usually by a more or less pronounced rigor. At this time the patient often vomits without having felt nauseated. He is rarely observed in this stage, and it is uncertain what the temperature and pulse are, but probably not

very high or rapid. This initial stage lasts from a few hours to four or five days, when the stage of somnolence comes on.

The patient now becomes quiet, and takes on a typhoid appearance. The mind is dulled. Questions are answered tardily, but correctly. The grasp of the hand is weak, perhaps weaker on one side than on the other. The pulse is very slow, and the temperature normal or low. The respirations are also slow. All of these symptoms may increase and end in death, or they take on symptoms of general meningitis. This meningitis may occur at any time, and indicates the leaking of the abscess into the adjoining cerebro-spinal canal. Then the end comes in a hurricane of convulsions, fever, and spasm, or in sudden death.

At any stage in the progress of the disease there may be an arrest of all symptoms and the patient may seem to recover. This latent or resting-stage may last weeks or years. The acute abscess is then said to have become chronic.

In a very few cases an acute abscess of the brain may terminate spontaneously in recovery. There are no cases known in which this favorable termination has come by the "absorption" of the pus or by its becoming encysted.

If the dura is broken, and the fracture open, the abscess may break through, discharge itself, and recovery follow. This is, however, the exception.

When there is infection and symptoms of abscess the wound should be opened, the bone removed, and the dura incised. The aspirator may be used to explore

the brain, and if the abscess is found it *must* be opened freely. The brain below rises up and quickly fills the space. A typical and classical case will illustrate the symptomatology, course, diagnosis, and treatment of this form of infection.

MACEWEN. *Cerebral abscess in parietal lobe and suppurative pachymeningitis subsequent to an infective depressed compound fracture of the skull, with penetration of the brain, coming under observation seven days after injury; trephining; removal of bone from brain; escape of pus, some blood, and cerebro-spinal fluid; washing out of abscess cavity; re-implantation of bone; complete recovery; duration of illness thirty days.* (*Macewen, Pyogenic Infective Diseases of the Brain and Spinal Cord. Glasgow, 1893, pp. 193–194.*)

D. M'P., aged 70 years, was admitted to the Royal Infirmary on the 7th of September, 1882, suffering from symptoms of pachymeningitis and intracranial suppuration, following upon a compound fracture of the skull, which he had received seven days previously.

He came of a long-lived, healthy race, and had been strong and well until this injury. He had had shivering on the fifth day after the injury, and when seen on the seventh day he was semi-delirious, very restless, complained of great headache, and frequently vomited. His rectal temperature was 103° F. On his injuries being examined, it was seen that besides several wounds of the scalp, he had sustained a compound depressed fracture on the right side of the head at the junction of the upper part of the occipi-

tal with the parietal bone, close to the longitudinal sinus. The external wound was suppurating, and it was evident from the symptoms that the dura mater, and probably also the superficial layer of the brain, were acutely inflamed and suppurating. He had paresis of the left leg.

In order to permit the elevation of the depressed bone and to allow the inflammatory products to escape, trephining was performed. The dura mater was found to be thickened and much congested, its outward surface partly covered with granulation tissue, and between this mass and the skull there were about two drachms of pus. (An extradural abscess.) This membrane was turned aside, when it was seen that a portion of the inner table of the skull, about an inch in length and three-quarters of an inch in breadth, had been driven into and had penetrated the cerebral substance for about half an inch. Around this fragment of bone there was a cavity containing pus, and on removal of the bone, several drachms of foul-smelling pus escaped from the brain substance (mixed infection). After the cavity had been irrigated with an antiseptic solution, it appeared red and flocculent, and from its walls several masses of buff-colored blood clot were removed. Over an ounce of cerebro-spinal fluid flowed slowly away; it was at first flocculent and turbid, but it ultimately became quite clear. After the wound had been rendered approximately aseptic, the pieces of bone which had been elevated were divided by the chisel and reintroduced, a fear being expressed that, owing to the age of the patient and the brittleness of the bone, these pieces might not be

able to retain their vitality. An antiseptic dressing was applied.

From the time of the operation he slowly improved, his mind clearing, and his temperature falling, and the crural paresis disappeared. The wound healed, all but an aperture through which a fine probe could be passed. This sinus led down to a small fragment of bone, which did not feel loose or distinctly necrosed, and in consequence it was left. After a time the sinus healed firmly, no bone having been shed. He was dismissed well about two months after admission. Two months later he was again examined, when there was a minute sinus leading to an exposed part of bone about the size of a threepenny piece, but quite firm. On digital examination the bone was found to be intact over the vault of the cranium. There was no hiatus.

Two years afterwards this patient presented himself at a clinical demonstration, given to the Southern Medical Society, Glasgow. He was then in good health, and had been regularly engaged at some light outdoor occupation since leaving the Infirmary, notwithstanding his advanced age. His head had not troubled him since. The wound on the head was quite healed, and the bone was firm.

The diagnosis of acute traumatic abscess of the brain depends upon the following conditions:

1. There is the history of an injury of the head, face, or pharynx; or signs in the way of suppurating wounds, edematous tissues, Pott's puffy tumor, or depressions of bone.

2. The general symptoms of infection are present,

an abnormal temperature and pulse, hyperleucocytosis, peptonuria, anorexia, and loss of vitality and interest.

3. The general symptoms of brain disease are present, headache of a very severe type, vomiting, a slow pulse as compared with temperature, sensory hyperesthesia, irritability, loss of strength, loss of ability to sustain protracted mental effort, followed by dullness, slowness, and hebetude, and even coma.

4. The localizing symptoms of brain disease are present. These depend entirely on the locality of the abscess for their prominence. They should be studied under localization of brain diseases, page 150. Hemiplegia, aphasia, hemiopia, unequal dilatation of the pupils, and monospasms are among the most significant symptoms.

The treatment of acute traumatic brain abscess is immediate approach to the abscess by the route of the infection, mechanical and chemical sterilization, or at least disinfection of that route and thorough emptying and draining of the abscess. If the symptoms do not subside, secondary abscesses should be looked for.

When the abscess is due to gunshot wounds or other foreign bodies in the brain, these bodies must be located with the X-rays, and removed as a part of the mechanical sterilization.

The prognosis of acute traumatic abscess of the brain, if left to itself, is almost invariably fatal; but when rationally treated the prognosis is more favorable. Delvoie reported 21 operations for acute traumatic abscess, with 15 recoveries; and Oppenheim,

including Delvoie's 21 cases, collected 53 cases, with 36 recoveries.

The end result in the cases that lived is, unfortunately, not known. In a few cases epilepsy followed, in a few mental idiosyncrasy, and in others bodily infirmity. In some cases, how large a per cent the clinical histories are too incomplete and too recent to determine, there seems to be absolutely normal cerebration.

CHRONIC TRAUMATIC ABSCESS OF THE BRAIN

The acute traumatic abscess may pass over into the chronic traumatic abscess. A foreign body sometimes remains in the brain for a long time and then some latent retained infection wakes up and gives rise to an abscess. Such cases frequently follow long quiet revolver bullets and other missiles lodged in the skull. They are now easily discovered by the X-rays. The essential clinical element which makes the diagnosis of a chronic brain abscess is a period of weeks or months after the symptoms of acute traumatic cerebral infection before the onset of the symptoms of brain abscess. This is the so-called "latent period."

The chronic traumatic abscesses, like those of otic origin, are surrounded by a limiting capsule of thickened fibrous tissue, the so-called "abscess membrane." These abscesses usually grow steadily and slowly, but sometimes they remain stationary and quiet for a long time. Occasionally a postmortem examination develops the fact that an old encapsulated and stationary abscess has given off fresh infection, and set up an acute cerebritis resulting in death. Sometimes an

encapsulated abscess breaks into a ventricle without having given any notice of its presence up to the moment of the catastrophe.

Chronic abscesses are pretty well encapsulated by the twenty-fifth day, but they are not fully protected before the sixth week. (Meyer.) The abscess is sometimes quite small, a centimeter in diameter, and again it is of enormous dimensions, filling almost all the space of both hemispheres. The chronic abscess has a most uncertain duration. It may terminate the patient's life after weeks or months, or even years. von Bergman mentions one case of twenty years' duration. The pus from a chronic abscess is thick and resembles mother of vinegar in consistency. It has a greenish color. It is usually odorless, and is frequently found to be sterile.

MACEWEN. *Cerebral abscess of traumatic origin in left frontal lobe, coming under observation ten weeks after injury; symptoms of bursting into the lateral ventricles at termination of the eleventh week; immediate operation; removal of three ounces of pus; relief of graver symptoms; persistence of slighter ones for a week thereafter; complete recovery; duration of disease eighty-three days (about twelve weeks).*

A. H., age 11 years, was admitted to the Royal Infirmary on May 9, 1889, on the sixty-sixth day of illness, suffering from cerebral abscess of traumatic origin, the injury having been inflicted ten weeks previously.

The family history was good, there being no tuberculous disease. The patient had been in perfect health until he was injured.

Ten weeks previous to admission (February 28, 1889) he was struck on the forehead with a stone, which produced a wound about an inch in length, situated in front of the brow, an inch above the left eyebrow. It was supposed to be only a scalp wound. The patient was dazed for half an hour after receiving the blow. He then appeared to recover and ran about for several days apparently well. The wound, however, suppurated, and was treated with bread poultices, and at the end of the third week the external wound was healed. On the fourth day after the injury he complained of pain in the head, which caused him to remain indoors for four weeks; it then became so intense as to compel him during the subsequent six weeks to remain in bed. The pain was of a dull, heavy character, subject to exacerbations of great intensity, causing him to cry out. During the last six weeks he became very drowsy, and when not complaining of pain, dozed constantly. Vomiting was frequent, on an average every second day, though sometimes it occurred several times in the twenty-four hours. About a month prior to admission, after vomiting, he several times sweated profusely (rigors?). His mother says that he had no shiverings, but that he had "peculiar turns," whether clonic spasm or actual rigors is a question. From the profuse perspiration it is probable that they were rigors. His bowels were constipated.

The patient, who was a fairly nourished boy, lay curled up in bed, usually on his left side, his head resting on his hand. He seemed exceedingly drowsy, yet he very frequently cried from pain, and tossed fret-

fully in bed. Occasionally he would sit bolt upright, staring around him for a few seconds with knit brows and a hazy, troubled, bewildered look, demanding things which when supplied were thrown by him wearily aside. He would then slide back on his pillow, passing again into his drowsy state. There were periods when he was quiet, the cloud had lifted from his brow, his eyes were brighter, and he apparently was at peace; these were, however, of short duration; his equanimity even in them was easily disturbed, a few simple questions sufficing to ruffle it, and to induce a recurrence of petulancy accompanied by exacerbations of pain.

His pulse was slow and weak, his respirations slow and somewhat irregular, and the temperature about normal. Touch and muscular sense were intact. Skin and organic reflexes were normal. There was no ankle clonus, and the patellar reflexes were very slight. The dynamometer showed the grasp of the two hands to be equal (18 kilos). Co-ordinate movements were well performed with both hands and feet.

Eyesight was fairly good; the patient could read large type. Pupils were unequal, the left being somewhat contracted; both reacted to light and accommodation, the left more slowly than the right. There was doubtful paresis of the left internal rectus. The ophthalmoscope showed double optic neuritis.

Both ears were normal. Hearing, taste, and smell were unimpaired.

Intelligence was fair when the boy was free from pain and his attention could be obtained. His memory, too, was good.

There was a firmly healed cicatrix in the forehead an inch above the left eyebrow, which was still tender. He complained of the left side of the head, and sometimes of the vertex as painful, the pain being increased on percussion.

The other organs were healthy.

During the seven days succeeding his admission, from the 9th to the 17th of May, he vomited occasionally, and frequently had marked irregularity of pulse and breathing. In the daytime he had long intervals of peace, lasting many consecutive hours, when he drank his milk, and seemed happy and contented. It was hard to convince those who saw him only during these blinks of sunshine that he was suffering from an abscess of the brain. At night after dropping soundly asleep, he would start with a low, shrill cry, would lie awake for a few minutes complaining of pain in the left temple, and would then doze off. This was many times repeated during the night. Frequently there were quiverings of the left eyelids, and twitchings on same side of the face. Towards the end of the week his sleep was more disturbed, and he moaned from pain for hours.

On the 17th of May, the symptoms presented a new phase. Early on that morning (1 A. M.) his respiration and pulse were markedly weak and irregular, his restlessness was incessant, the pain in his head greater, and vomiting frequently recurred. About seven in the morning he vomited, after which he lay down quietly as if going to sleep, when the nurse observed that his face and lips became extremely pale, and he could not be roused. His pupils were both dilated,

and his left leg became rigid. A series of circular movements were made with the left arm, which were repeated after an interval. These were not convulsive, however, though they seemed to be automatic. The breathing became very labored. After remaining in this state for five minutes, the patient gave vent to a low, shrill cry and awoke, not being aware of what had happened during the interval. While in this state his respirations were 28 per minute, his pulse 60. The temperature immediately afterwards was 97° F.

The vomiting, restlessness, and prostration continued during the next few hours. At twelve noon he had a fit which lasted twenty minutes. It was preceded by vomiting, and consisted of a series of convulsive movements of both upper limbs, more marked in the right. These continued for four minutes, when both arms became rigid, flexed across the chest, the hands being clenched below the chin. During this period both lower limbs became rigid, but there was no convulsion. The patient then had a series of opisthotonic attacks, in the first of which he turned on his left side and became bent like a bow, the whole body being rigid: pleurothotonos, *arc en circle laterale.*

This lasted three minutes. He then became quite relaxed; this was followed by two other similar opisthotonic attacks, the patient's body being supine, arched, stiff, and resting on his head and heels. The two later attacks were of shorter duration than the first two, lasting about two and a half minutes each. During the fit the pupils dilated, the left markedly more than the right. The respirations were stertorous and hurried (38 per minute). There was great lividity

of the face throughout. The pulse was very irregular. Three minutes after the fit had passed off, the patient was able to speak intelligently, but was not aware of what had occurred, thus showing his unconsciousness. For three hours subsequently he lay prostrate in a semi-insensible state and extremely pale.

At 3 P. M. he became totally unconscious, with lividity of the face, absolute flaccidity, and absence of reflex movement. His pulse, which had previously ranged from 30 to 60, had risen suddenly to 130; his respiration, which was labored, ran about 30 per minute; the temperature was 96.8° F. The pupils were widely dilated and fixed. This sudden change in the symptoms and their nature betokened involvement of the lateral ventricles. It was hoped that the lining membrane of the ventricles had alone become involved by extension of the inflammatory action; that there had been at most an oozing of pus from the abscess into the ventricles. Immediate operation was decided upon.

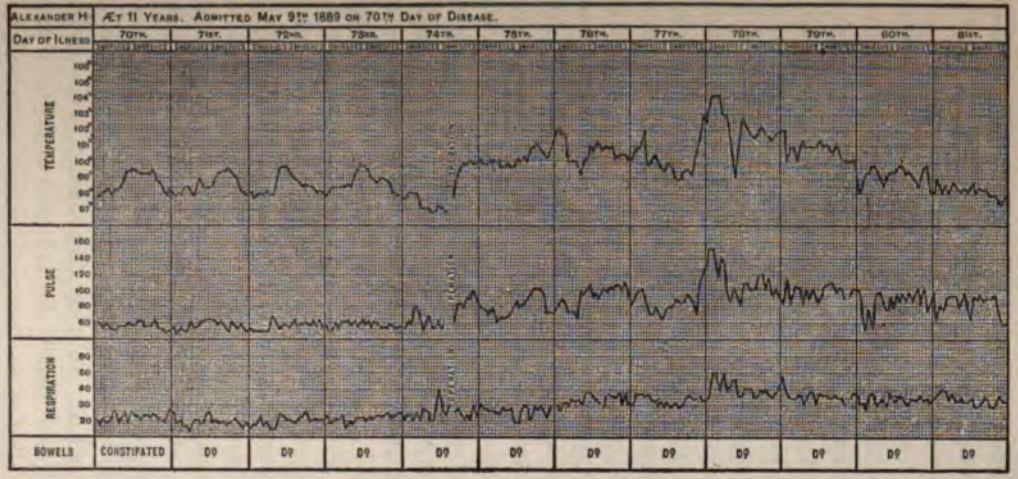
The operation was performed. As he was absolutely comatose, no anesthetic was employed. An incision was made over the cicatrix, and some minute portions of bone were found slightly indented. These were removed and an aperture was made in the skull a quarter of an inch in diameter. The dura mater was thickened and bulged somewhat into the opening, and no pulsations were visible. It was reflected, and the inner membranes were found adherent to it, the latter showing some congestion. The brain bulged into the aperture. There was no pus between the membranes or on the brain surface. The surface of the brain

seemed rather paler than usual. A hollow needle was introduced into the frontal lobe in a direction backward, downward, and somewhat inward, so as to strike, if carried far enough, the anterior cornu of the left lateral ventricle. After the brain was penetrated for about an inch, a cavity was reached from which pus flowed freely. The pus was of a yellow color, almost odorless, and measured three ounces. With a view to the cavity of the abscess being more thoroughly drained, an opening was made laterally about half an inch in front of and a little below the stephanion. On this being done, the dura mater was found to have collapsed inwards away from the skull towards the abscess cavity, leaving a considerable portion of the interior of the skull bare. This had probably been caused by the removal of the pus. Had the dura been penetrated here the escaping decomposed pus from the abscess cavity would possibly have collected between the dura mater and the skull, and set up extensive pachymeningitis. The dura was therefore left unopened at this point, and the minute drill-hole was dressed. A full-sized decalcified chicken-bone drainage tube was introduced through the brain by the anterior opening in the skull into the abscess cavity, and a small quantity of carbolized watery solution was injected, but the thorough irrigation of the cavity was not proceeded with as in other cases, lest the fluid injected should reach the lateral ventricles, carrying along with it particles of decomposed purulent matter, and from possible retention cause over-distention and further brain mischief. The usual woodwool dressings were applied thickly sprinkled with iodoform.

During the operation pulse and respiration markedly improved after the evacuation of the pus. Sensibility to pain returned towards the end of the operation.

After the operation the patient recovered consciousness and slept for some hours quietly. When he awoke, though extremely weak, he asked for and drank milk with evident relish. Towards night the restlessness returned, shown by his trying to sit up, turning about from side to side, and making what appeared to be half-voluntary, half-automatic constant movements of the left arm. Several times there was a doubtful squint of the left eye. The restlessness, the pain in the head, the high temperature continued during the first week subsequent to operation. On the 19th a new feature presented itself in the shape of diarrhea, which continued more or less until the 23d day, then subsiding. At first the motions contained undigested milk, mucus, and blood. The dressings were renewed once during this period, as owing to his restlessness they had shifted somewhat. The wound looked well, though there had been an oozing of pus. On the second dressing three weeks after the operation, the drainage tube had disappeared, and the wounds were covered with granulation tissue. They soon healed firmly. The patient was kept in bed for over a month. He was then quite convalescent, and soon recovered his usual health and strength.

Observations of the temperature, pulse, and respiration were taken every hour from the 13th of May until the 24th of May. The temperature, pulse, and respiration became normal at the latter date. The optic neuritis began to disappear at the end of the



61. Chart of temperature, pulse, and respiration in a case of traumatic cerebral abscess in the frontal lobe bursting into lateral ventricle.

third week, and on examination at the end of July, eleven weeks subsequent to the operation, it had all but disappeared.

The history of the period prior to his coming under observation was defective, as the mother, an uneducated woman, could not describe what she saw with sufficient accuracy. There can be little doubt rigors occurred during the initial period, whether observed or overlooked, and it is probable that these "turns" which the mother referred to were of this nature. The age of the abscess before operation was probably between seven and eight weeks. The symptoms of the involvement of the lateral ventricles became decided on the day succeeding the completion of the eleventh week from date of injury. The amount of pus evacuated (three ounces), if placed in the frontal lobe of a boy aged eleven, with its anterior boundary an inch from the anterior surface of the brain, would have its posterior boundary in the immediate proximity of the anterior horn of the lateral ventricle. The symptoms described as occurring on the day of the operation, as well as those manifesting themselves subsequently to the operation, leave little doubt that the lateral ventricles were involved, and that the pus had actually found its way into them. The sudden onset of the grave symptoms, the excessive irritability, incessant tossing about, repeated vomiting, weak pulse and respiration, followed by rigidity of the muscles and convulsive movements which were bilateral though most marked on the right side, the opisthotonic attacks, and finally the extreme rapidity of the pulse, with lividity of the face, extreme prostration, complete

coma, and widely dilated, fixed pupils, all betokened the bursting of the abscess into the lateral ventricles. A few hours' delay in operating would have proved fatal. After the operation the continuance of the restlessness and semi-delirium, the pain, high temperature and occasional twitching of the muscles, indicated that the irritation had not subsided, though the pus had been removed. This persistence of the symptoms of cerebral irritation after the operation was in marked contrast to the conduct of the uncomplicated cases of abscess of the brain in which the ventricles had not become involved. In these the relief of the symptoms was immediate and complete. The state of the brain and its peripheral membranes, as exposed in the operation, showed that there was no trace of external meningitis from bursting of the abscess superficially. In respect of the involvement of the lateral ventricles, this case resembles the second one of cerebral abscess which came under the writer's notice, and which very shortly thereafter manifested symptoms of the abscess having burst into the lateral ventricles. In that case the temperature as well as the pulse and respiration increased with a bound, the coma becoming complete within an hour, the breathing stertorous, accompanied by great lividity of the face. The lateral ventricle was found at the operation full of pus, the wall of the abscess on that side having broken down. In contrast to that, in the present case the symptoms, though rapid, were more gradual, and it is probable that the pus from the abscess had oozed slowly into the ventricles.

The diagnosis of chronic traumatic abscess of the

brain is attended by unusual difficulties. It must depend on a clear history of the case; an injury of the head, the primary brain symptoms, a latent period, and the final symptoms, or onset of the chronic abscess.

The initial injury may be trifling or severe, but unnoticed, either on account of the concussion of the brain at the same time or because of drunkenness, aberration of mind, or an epileptic attack. The scar or the open wound can usually be found. In some cases there is no history attainable as the patient comes to the surgeon in an unconscious condition. Then the scar or evidence of fracture with the final symptoms of abscess are all that is left.

The latent stage, free from all symptoms, a period of good feeling and often of activity, is a most characteristic symptom. Sometimes there is a series of exacerbations of brain symptoms, and latent periods. The duration of the latent period is not uniform, sometimes a few days, more often a few weeks, but in rare cases a number of years.

The terminal stage or period comes on gradually with pain, or suddenly with chills, convulsions, or sudden coma. The most common and prominent symptom is pain. This is usually boring, radiating, increasing on movement of the head, and intermittent in character. It shoots over the head suddenly or throbs with each heart-beat. Sometimes there is neuralgia of the trifacial nerve on one or both sides, and the pain appears in the face. The location of the abscess and its extent and rapidity of progress determine the localizing symptoms. The temperature is

not very high, but the pulse is markedly lower than would be expected in sepsis located elsewhere, and therefore typhoid is suspected. The Widal reaction is not present, but there is a marked hyperleucocytosis. The respirations are also slow. The peptone reaction is present. There are irregularities in the quantity of urine and in its constituents which are not easily explained. The aroused abscess may be so near the membranes of the brain as to set up a meningitis, the symptoms of which obscure those of the abscess and confuse the surgeon. Even thrombosis may occur, and then the symptoms of otic brain abscess may lead the attention away from the true source of the infection. Headache and neuralgic pains are quite constant, but not pathognomonic. These pains often center about the scar. They increase with every movement of the head and on pressure over the scar. The neuralgia is most often confined to the fifth nerve. Low fever is usually present at this time. Localizing symptoms are with all these conditions very significant and almost diagnostic. Sometimes a localizing spasm clears up the diagnosis. A cry or an epileptiform convulsion may indicate the beginning of the end.

If the symptoms are carefully analyzed, there is found to be a period of a few hours or a week which may stand for the onset, a second period or stage of somnolence, and then a final period of unconsciousness or storm, ending in death.

In the initial period there is hyperesthesia, chill, rise of temperature, rapid pulse, vomiting, headache, tenderness over the abscess, photophobic irritability, excitement, and restlessness.

In the second stage the temperature may remain about the same, but the pulse is slower, the respiration retarded, the patient is somnolent and anesthetic, weak, and even paralyzed, and the intellect dulled and slow. The terminal period may come on slowly with symptoms of increasing intracranial pressure, or suddenly with symptoms of rupture of the abscess into the cerebro-spinal canal.

The prognosis is always bad if the abscess is left to itself, but relatively favorable if properly drained.

The indications for treatment are the same as in acute abscess, but the prognosis is much better.

W. P. Verity (Surgical Diagnosis of Fractures of the Skull, North American Practitioner, Vol. V., 1893) reports the following instructive case:

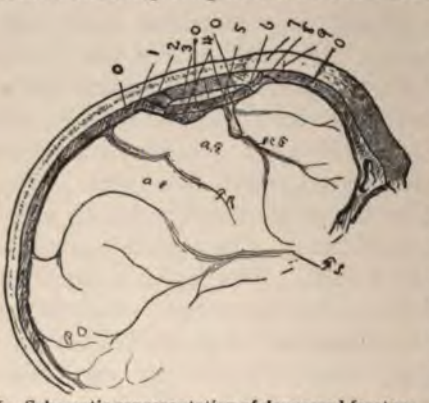
A Scotch-American, 27 years old, entered the hospital January 13, 1893, with the following history: Six weeks previous, while on a Mississippi River steamboat, he had fallen asleep near the steam pipes. An engineer, under the belief that he was drunk, struck him on the head with a monkey-wrench. He was unconscious for two days. When he came to himself he was in a St. Louis hospital, where he remained three weeks. During the first two weeks of his stay he had much pain about the head, headache and lancinating pain at the seat of the wound. During his hospital residence the injury was considered a scalp wound and so treated. Three weeks later, his condition justified, in the opinion of the hospital surgeon, his discharge as a convalescent. He then came to Chicago and had recurrent attacks of dizziness and

exhaustion which so interfered with his work as to compel him to seek hospital treatment.

On examination a scalp wound was found on the right side of the head one inch below the median line and one inch back of the forehead. It was about an inch and a half in length. It was almost healed, but at the anterior end was a small sinus lined with exuberant granulations, elevated about a line above the surrounding scalp. The mouth of the sinus had a pouting appearance. Pressure on and about the wound caused no particular pain. No nervous symptoms other than marked vertigo were observable. The patient consented to the administration of an anesthetic, which was well borne. The scalp was thoroughly cleansed and shaved. Free incision over the seat of injury caused much hemorrhage. This being checked, the field of operation was carefully explored. Very little pus and some granulations and bone denuded of periosteum were found. While scraping the granulations away a scrap of cloth was found, about three inches in length, black, and somewhat stiff. This was clearly a fragment of the hat worn at the time of the injury.

The fractured area was about an inch and a quarter wide by two and a quarter inches long. The most depressed area measured three-eighths of an inch by an inch and a quarter. The surrounding portion was tilted obliquely, joining this area with the skull. The fragments, twelve in number, were singularly uniform in shape, and so firmly wedged together that no instrument could enter between. The depression was about a quarter of an inch below the level of the skull. The

fracture outwardly resembled a small dish, in being oval and uniformly depressed. Trephining over the posterior part of the fracture removed a button of bone composed of parts of three fragments. The outer table seemed to be separated from the inner. The remaining fragments of the outer table were easily removed with the chisel, despite the fact that all were seemingly wedged firmly together. Most of them appeared to be separated from the internal table. The fragments of the internal table were of the same outline as those of the outer. They were firmly wedged together, but were separable from the skull with difficulty, since they extended under it. Between the posterior half of the most depressed portion and the dura mater was an abscess containing a drachm of pus. Under the anterior half was found an abscess with an exit through the dura mater, one-eighth of an inch long. (See 4 in Fig. 62.)

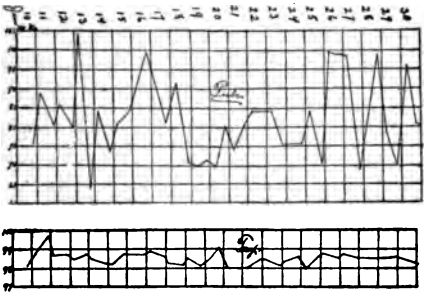


62. Schematic representation of depressed fracture of the skull. (Verity's case.)

1. Dura mater. 2. Side of depression. 3. Floor of depression. 4-4. Pus. 5. Slot in dura mater. 6. Point of trephining. 7. Median line ant. post. 8. Fract. of inner table. 9. Distance of fract. from median line. o-o-o. Cut section of skull.

This latter abscess cavity was about three-quarters of an inch deep and had held about a drachm. The

opening in the dura mater was slightly enlarged with scissors and gently irrigated. A piece of brain tissue the size of a buckshot was washed out. This cavity was gently packed with iodoform gauze. The brain seemed to resume its normal proportions on removal of the remainder of the bone. The wound was thoroughly cleansed, the granulations removed, and the cavity packed with iodoform gauze. The dressing consisted of sublimate gauze, absorbent cotton, wax paper, and plaster of Paris bandage. The temperature and pulse ranged as above.



63. Pulse and temperature record in a case of brain abscess following depressed fracture of the skull.

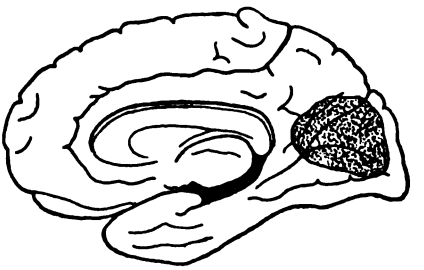
The wound had healed completely by February. The patient felt well, and went to look for work. Since the end of February nothing has been heard of the case.

Eskridge, J. T., Three Cases of Chronic Abscess of the Brain, the Medical News, July 27, 1895.

W. E., 31 years old, a ranchman, was admitted to the hospital January 22, 1895, with a diagnosis of typhoid fever. The condition of the patient was such that it was impossible to get either a family or personal history. He had led a very irregular and dissipated life, and contracted syphilis four years previously. After his death it was learned from his

brother that he had received a blow, several months before, on the right side of his head. He was unconscious for a time, and after recovering went to work, frequently complaining of dizziness and great weakness. Unfortunately this information was not obtained during the patient's stay in the hospital. The only information obtainable from the patient was that he had had headache for about two months, from the middle of December previous, which became intense and constant, and was located on the right side of the head in the frontal region, but occasionally extending back to the occiput. He was confined for several weeks in an out-of-the-way place, where he had no medical attention; he had emaciated rapidly, and was supposed by his friends to be suffering from typhoid fever; he was transported in a partially covered wagon for thirty-five miles during intensely cold weather. At first he was put into the medical wards, but afterwards, on account of headache and paresis of one side of the body, he was placed under the care of Dr. Eskridge. A catheter could not be passed. Two hours after his admission to the hospital he was examined. When left alone he lay in bed breathing quickly and apparently sleeping; when spoken to he would rouse up for the moment and answer a question, but concentrated mental attention was impossible; he would relapse into a semi-conscious condition. The left arm and leg were each weaker than the right, with a tendency to flexion or contraction of the arm below the elbow. The face did not seem to be affected. The knee jerk was increased, the left exaggerated; ankle-clonus was absent on the right side, but decided and continued on

the left. The plantar reflex was very slight, the left absent; the right cremasteric reflex was present, the left absent; the extensor reflex of the forearms was normal on the right, exaggerated on the left; the biceps and triceps reflexes were normal on the right, exaggerated on the left. On account of the man's mental condition it was found impossible to test his vision, but he was found completely hemianoptic in the left half of each visual field; the pupils responded slightly to light; both optic nerves showed slight swelling with considerable atrophy, narrowing of the arteries, and slight tortuosity of the veins, with almost total obliteration of the line of demarcation between the nerve and the retina. The swelling of the optic disk amounted to a single diopter. His temperature was 97.4, his pulse 40, and his respiration 16.



64. Encapsulated abscess in centrum ovale of right cerebral hemisphere.

The urine contained pus, albumen, and renal casts.

The man was placed upon unctions of blue ointment, and rapidly increased doses of potassium iodide on the supposition that his brain lesion was due to syphilis. The next morning it was found almost impossible to rouse him; his temperature was 97 in the right axilla, 98 in the left, his pulse 52, and his respiration 12. He gradually grew worse, his temperature

falling to 97, and he died in coma five days after admission. On the morning of his death his temperature raised to 104.6, his pulse became uncountable, and his respiration was 56. The abscess was found in the right cerebral hemisphere in the centrum ovale, was two and one-half inches in diameter, and one-quarter inch below the dura.

ABSCESS OF THE BRAIN OF OTIC ORIGIN

Since the great proportion of abscesses of the brain spring from disease of the middle-ear, and especially since nearly all of the hopeful brain abscesses spring from the petrosa, it is necessary to make a careful study of the anatomy and physiology of the ear and the sources of all diseases of this organ. A little apparent diversion may be necessary in order to consider those diseases which are liable to be mistaken for middle-ear disease or are predisposing factors in its onset.

NASOPHARYNGEAL ADENOIDS

The prime cause of middle-ear disease in the great majority of cases is the presence of an abnormal development of the so-called adenoid tissue which occupies the posterior nares. These masses of hypertrophic lymph tissue are apt to appear in children in our dusty, close houses, especially if the child suffers at the same time from the so-called scrofulous diathesis. The presence of vegetations is recognized by the fact that the child is a mouth breather, and snores at night or when asleep. The obstruction is so great that when the child is awake it assumes a peculiar attitude of the lower jaw and tongue, resulting in a gaping appearance. The effort to breathe during

the night causes hypertrophy of the muscles of the diaphragm and a bending in of the attachments of the ribs to the diaphragm, forming two apparent sulci along the lower border of the anterior portion of the chest. The poor aeration of the blood results in venous stasis, and the appearance of a network of blue veins over the chest, abdomen, and neck, and even extending to the extremities. The presence of infection in the adenoid vegetations is apt to be followed by inspiration of this infectious material, and a chronic bronchitis. Locally this infection renders the Eustachian tube edematous and destroys its function, and the child suffers from periods of partial deafness. The Eustachian tube frequently becomes infected, and when no worse catastrophe follows, retraction of the drum may occur, with relative deafness later in life. The relative deafness, which afflicts these children from time to time, usually gives them the appearance and attitude of stupidity. At least twenty per cent of the children of the fifth grade in our city public schools suffer from nasal adenoids, and among these are to be found the most troublesome and most backward pupils. They are troublesome because their dispositions have been destroyed by parents and teachers who failed to recognize their lack of hearing, and they are stupid because they are unable to take advantage of the instruction which must come to them through the ear.

Ferdinand I. of Spain, whose picture is in the Uffizi galleries at Florence, was a sufferer from adenoids, and all his family have the typical adenoid face. From the time of Ferdinand to the present, the house-bred children of the rich, more than others, have been

prone to suffer from adenoids, and on account of the expression of the disease on the neck and chest they have been called blue-blooded.

If the germicidal power of the blood is reduced from any cause the infected mucus passes up the Eustachian tube to the middle ear and antrum, and gives rise to that terrible disease which may well be called the appendicitis of the head. This disease, according to its clinical manifestations, is called middle-ear disease, otitis media suppurativa, mastoid disease, or otorrhea. The presence of the disease in those who are not suffering or who have not suffered from nasal adenoids is very rare indeed.

65. Type of Adenoid face.

The treatment of nasopharyngeal adenoids is prophylactic, medicinal, or surgical. The prophylactic treatment consists in the proper housing of the infant and growing child. The house dust and the close air of over-heated sleeping-rooms seem to be the principal factors in encouraging the growth of adenoids, and hence their elimination is in every respect desirable. This is especially the case with the so-called scrofulous

children, or those of a lymphatic diathesis. The character of the child's food and the extent to which it lives out of doors are probably other important considerations. The use of flannel clothing over the chest and the habit of the cold morning bath are also prophylactic measures. The growth of adenoids is stimulated by colds, and they fluctuate with the seasons, appearing to increase in early winter, subside somewhat as cold weather is established, and appear again in the spring; these variations in size are doubtless due to the habits of the several seasons. Postnasal adenoids come on early in life, and in the majority of cases, having deformed the nose, jaws, and respiratory apparatus, disappear soon after puberty. Exceptions to the general rule, however, are found in the many adults who suffer of most exaggerated forms of the disease.

The use of iodide of iron, either with or without cod liver oil, is a popular agency in arresting the growth of adenoids, or driving them away. While these remedies are useful, and should never be neglected, they cannot wholly be relied upon. It is a fact that laxatives and a restricted diet give relief from the acute manifestations of the disease.

The only reliable treatment of nasopharyngeal adenoids is careful and complete removal, usually with the coincident excision of the pharyngeal tonsils. The operation can be accomplished under nitrous oxide anesthesia, the head of the patient hanging over the well-padded end of the table, and the hair covered with a rubber cap. The operator places a gag in the child's mouth, carefully wipes out the nose and pharynx with small sponges wet in boric acid solution,

and then scrapes away the adenoids with the nail of the index-finger. As substitutes for the finger-nail various instruments have been devised, all of them liable to inflict serious injury unless used by the thoroughly trained rhinologist. The inexperienced operator is prone to err, especially in aggravated cases, in leaving a fringe of adenoids in the very highest part of the nasopharynx, and around the posterior border of the nasal septum. Complete removal may be insured by covering the tip of the operating finger with a bit of gauze, inserting it into the posterior nares, and by twisting it around scrape off the last vestiges of polypi. In the very worst cases it may prove necessary to insert a six-inch forceps through the anterior nares against the finger, and thus grasping the otherwise inaccessible adenoids in the jaws of the forceps, twist them off.

Hemorrhage following this operation is ordinarily very slight, and can be stopped by sponging out the posterior nares with dry gauze sponges on the point of the index-finger. This procedure has also the advantage of removing infected shreds of adenoid tissue which might else cause recurrence. The operation ought not last more than five minutes, or in cases complicated by the removal of the tonsils, not longer than fifteen. The dangers associated with this operation are largely to be attributed to the anesthetic, and it is a peculiar fact that the number of fatalities reported is out of all proportion to the simplicity of the surgical measures employed. Some two hours subsequent to the operation, and after the patient has reacted from the anesthetic, he will usually vomit a quantity of black, clotted blood, swallowed during insensibility. In the

case of a child, the relatives should be apprised of the likelihood of this phenomenon, since to the uninitiated it is suggestive of the most alarming conjecture.

Children recover from this operation easily and quickly. Within a few minutes after returning to consciousness the face of the child assumes a pink color, probably due to unusual sympathetic stimulation by the unaccustomed passage of air through the nares. In the course of two or three hours the child exhibits its normal activity, and provided the tonsils have not been included in the excision, eats its next meal without discomfort. Cleanliness of the nose and pharynx is a postoperative precaution which should be enforced so far as possible, but the use of any antiseptic wash is, in the case of children, impracticable.

CIRCUMSCRIBED INFLAMMATION OF THE EXTERNAL AUDITORY MEATUS

Boils and inflammations of the external meatus are of considerable diagnostic importance because of the fact that they are sometimes mistaken for middle ear disease on account of their resemblance to otorrhea. The most common form of the disease is a simple furuncle which closes the meatus and at last breaks open through a follicle of the skin and discharges itself, sometimes with a considerable necrotic mass or core. From the furuncle a diffuse inflammation goes out into the auricle and gives rise to protracted suppuration, destroying the cartilages of the ear, and producing unseemly deformities.

The disease is apt to occur in diabetes, in debilitated persons, and old people. It has been found due

to the pyogenic staphylococcus and streptococcus. It often follows the bad habit of digging out the ear with pins, hairpins, or pieces of match.

Bromide of potassium is often considered the cause of boils in the ear. Furunculosis of the ear is sometimes apparently an epidemic. It is certainly an infectious and probably a contagious disease. It has been attributed to the use of the phonograph. It is more frequent in spring and autumn than during the rest of the year. It rarely occurs in children. It is improperly called a catarrhal inflammation of the meatus.

S. Macewen Smith (Medical News, January 14, 1895) observed during the fall of 1890, 117 cases of boils of the meatus, 62 of which came from a locality embraced within an area of about a mile square; 46 of this number were males, and 16 females; 51 were suffering at the same time from an acute attack of influenza, but without severe constitutional disturbances; while 11 showed no apparent illness whatever. As to the situation of the boils, 52 were in the cartilaginous meatus, 4 in the deep osseous portion, and 6 at the extreme outer end of the canal.

The symptoms in the early stage are itching, followed by pain, increased by moving the ear and by closing the jaw. After the swelling closes the meatus there is some deafness which disappears as soon as the meatus opens. If neglected, the cartilages of the ear are sometimes infected and the tympanum itself may be ruptured inward and destroyed.

It is certain that there are occasional cases of diffuse inflammation of the external ear. Some of these are due to the presence of a fungus, aspergillus.

Some seem to be of a diphtheritic character. Occasionally erysipelas is met with, and very rarely, indeed, condylomas of the ear are seen in syphilitics. A form of hemorrhagic otitis is occasionally met with in influenza, in which blood exudes from the walls of the meatus and from the membrane. An inflammation of the external ear is believed to have set up a meningitis, even when the middle ear itself was unaffected. These two forms of infection are important in relation to suppurative disease of the middle ear, because middle ear disease, when long neglected, gives rise to infection of the external meatus and of the auricle itself.

Eczema of the meatus, even without the presence of the disease elsewhere, sometimes occurs in gouty patients, and in those who have suffered from middle ear disease for a long time. In this connection, impacted wax must be remembered.

The treatment consists in perfect cleansing of the meatus and the removal of the hairs. Ether and alcohol should be used freely to dissolve the wax. Scales of skin should be mechanically removed. Except in cases of uncertain diagnosis the boil should freely and deeply be opened after the parts have been locally anesthetized. On account of the tendency to recur the ear should be carefully sterilized and kept dressed for a long time.

Foreign bodies are sometimes placed in the ear by children, hysterical or demented people, and by the very old. These foreign bodies after a long time give rise to suppuration, or bloody discharge, which might be mistaken for middle ear disease. They should be treated very carefully in order to secure their removal

without rupture of the drum or loss of the foreign body in the middle ear. Perhaps nothing is more embarrassing than to find that a foreign body which was in a perfectly harmless position in the external auditory meatus has been lost, through lack of skill, in the middle ear, whence it can be removed only with the greatest difficulty, and where it may give rise to middle ear disease, meningitis, or abscess of the brain. (See Occidental Medical Times, August, 1900; Archiv. für Ohrenheilkunde, May, 1895, and Münchner Med. Wochenschrift, April 27, 1897.)

Among the helpless inmates of some institutions, and in convalescents from severe typhoids poorly cared for, a bloody discharge from the ear is sometimes found to be due to parasites. Bedbugs under these circumstances sometimes make their nest in the ear, and by irritating the membrane and wall of the external auditory meatus, they produce a suppurative condition which is accompanied by bleeding.

The ordinary physician should never use anything in the ear except an injection of very warm bicarbonate of soda solution. The fountain syringe should not be held too high. In this way foreign bodies can be loosened from their attachments and washed out, and the impaction of cerumen, which is often mistaken for a foreign body, can be softened up and removed.

Packard (Journal American Medical Association, May 12, 1900, p. 1160) mentions eleven cases out of fifteen hundred consecutive cases at the Pennsylvania Hospital of rupture of the membrana tympani. He gives a full bibliography of the subject at the end of his article.

CHAPTER VIII

OTITIS MEDIA

Frequency; source: through meatus, through Eustachian tube; fore-runners; composite example. Anatomy: Eustachian tube, middle ear, antrum, mastoid sinuses, squamosal sinuses, adnexa. Examination of membrana tympani: apparatus, technique. Treatment: catarrhal, paramastoid abscess, mastoid abscess, antrum infection, intracranial extension. The radical operation: indications, preparation of the patient, dangers of the operation, complications. Topography; description of operation; instruments; technique; after-treatment.

The surgery of the head, and especially the surgery of the brain and its membranes, is a most unfruitful field for surgical adventure. Here, however, is one condition, both common and terrible, in which surgery offers a relief complete in proportion as it is promptly and efficiently instituted.

Our knowledge of middle-ear disease, its course, its dangers, and the indications for treatment, are so thoroughly systematized and so explicitly stated that there is no more reason for error than there is in obstetrics. It is one of the best written chapters in surgery. Yet at the present time there is no disease so much neglected in every stage of its course, there is no disease so much tampered with by incompetents, and there is no disease for which

such unwarranted and irrational operating is undertaken.

There are no reliable and adequate statistics at hand showing the frequency of middle-ear disease. It is much more common than the ordinary observer believes. Until some careful investigations of the condition of the ears in a large number of children in our public schools are published we can hope to have only a relative notion of its frequency.

It appears from a study of a series of persons in various walks of life that one out of three has some sort of abnormality of hearing, and that the bulk of all diseases of hearing are due to middle-ear disease. Probably not less than seventy per cent of all diseases of the ear and tube treated in offices and clinics are due to middle-ear disease, twenty-four per cent to disease of the external, and less than ten per cent to disease of the inner ear itself. The greatest number of cases of ear disease are to be found in early life. Among children the little girls are more subject to the disease than little boys, but after the twelfth year the curve gradually rises for the boys and falls for the girls. Among twenty-two thousand ear cases treated at the Göttingen polyclinic, twenty-eight per cent were in the first ten years of life, twenty per cent in the second ten years, twenty per cent in the third ten years, twelve per cent in the fourth ten years, nine per cent in the fifth ten years, six per cent in the sixth ten years, and the balance in the seventh and eighth.

As regards the frequency of the disease in one ear or the other, or in both ears, it is interesting to note that the left ear is affected about twenty-seven times

to twenty-five times for the right ear, and that the disease is bilateral or affects both ears in 49.93 per cent of all cases.

As regards the season of greatest frequency of disease of the ear, it is interesting to notice that the minimum is in the fall or early winter, and the maximum is in the spring or late winter.

Otitis media is a disease which is only rarely produced by direct infection of the middle ear through the introduction of a foreign body or instrument through the membrana tympani. In my own observation I have seen only one case of this kind, and in a large clinic there have appeared only occasional instances of this kind. Most cases arise through infection from the pharynx by direct extension through the Eustachian tube at a time the vital resistance of the patient is lowered. After the first attack the disease arises from multiplication of spores in the residue left in the ear from the old infection. This is especially the case with the so-called cholesteatomas, which are found in the attic, the antrum, and occasionally in some of the other mastoid cells.

The only patient that the author has observed suffering from suppurative disease of the antrum in which the infection was directly through the drum presents a case sufficiently interesting and suggestive to be repeated here: The patient, when she came under observation, was a girl twelve years of age. She had suffered from repeated attacks of mastoiditis for eight years, with a constant otorrhea. During each summer the discharge became much less. When the little girl was four years old she is supposed to have forced a

small stone into the external auditory meatus of her left ear. It gave rise to a swelling, and a doctor attempted to remove it, and in doing so drew blood. Following this the child was very sick for a week, at the end of which time she was taken to a clinic. An aurist removed a small stone from the ear, and said that the drum was destroyed, and that the child would probably have imperfect hearing. He took care of the child for several weeks, repeatedly irrigating and examining the ear. The discharge, however, did not cease, and treatment was discontinued. During the succeeding eight years she was brought before a number of aurists and surgeons, all of whom advised a course of treatment, and promised eventually a radical operation if the discharge could not be stopped. At our first examination the ear was found discharging freely a fetid and extremely offensive pus, although it had received careful attention for two or three days before. I found the drum completely destroyed, and the middle ear nearly filled with a mass of granulation tissue, which bled at the slightest touch. The mastoid itself was tender externally as high as the antrum, and higher. The child's temperature was a degree and a half above normal every night, and every noon, at the first examination of the day, it was above 99. Two blood counts were made, both of them showing a diminution in the red corpuscles and a leucocytosis exceeding eighteen thousand. The little girl was sick and miserable, and had a cough with no evidence of tuberculosis, and no evidence of mouth breathing. The urine showed no disease of the kidneys. Considering the duration of the disease, the condition of the

patient, and the character of the discharge, an immediate radical operation was recommended without waiting for any treatment calculated to wash out the attic and attempt the arrest of the discharge. The patient was, therefore, put in the hospital and subjected to the ordinary preparations and operated on in my clinic. The ear had been thoroughly cleared out, and yet, on the operating table, it was found to contain a drop or two of fetid pus. The ordinary incision was made under chloroform anesthesia and the antrum opened without difficulty with a small gouge and hammer. It was found filled with granulation tissue and fetid pus. No scales of cholesterin could be found in the pus. The roof of the antrum was not perforated. The squamous and the mastoid cells were both full of fetid pus and granulation tissue. The bone itself was vascular and softened so that it was easily scraped away with a sharp spoon after the surface had been removed with a chisel. The squamous and mastoid cells were completely obliterated, and the antrum was freely opened into the tympanum. The antrum was packed by a piece of gauze coming out through the middle ear and external auditory meatus. The auricle was brought back and the upper portion of the wound closed. Another piece of gauze was packed down against the antrum from immediately behind the meatus, and the lower portion of the wound over the mastoid was also closed. The condition left was one of through and through drainage. The patient had no paralysis and no interference in recovery.

Otitis media follows scarlet fever and measles more

frequently than any other of the infectious diseases of children. Formerly diphtheria was a precursor of otitis media, but through the conquest of this disease by antitoxic and sanitary regulations, its potency in this respect has greatly declined. Following measles the symptoms and course of the disease are less severe and less rapid than following scarlet fever. The history of such a case is something like the following: after the eruption has made its appearance, and the temperature has followed its characteristic curve and fallen to normal for a few days, the temperature suddenly rises to 104 or 105, with a chill. The blood shows an alarming increase of leucocytes. The urine contains albumen and casts. There is a slight cough. The liver is enlarged. The patient complains of a severe pain in one or both ears or in the side of the head, but sometimes the symptoms of hyperpyrexia cover the local symptoms and give no suspicion of disease in the petrosa. The first symptom of a local disease is, then, the appearance of discharge from the meatus, and if an examination is made, the membrana tympani is found ruptured. Coincident with this discharge the temperature falls and the general condition of the patient improves. In young children, however, the temperature is apt to remain persistently high. In some cases the membrana tympani does not give away. A swelling appears behind the ear, indicating an extension of the inflammation in this direction or a perforation of the petrosa by way of the Rivinian fissure, and the production of a subperiosteal abscess behind the auricle.

Should this abscess open and discharge itself, the

toxic properties of the pus are still carried within the skull, producing mental hebetude, pain, and psychic symptoms. The external wound closes after a time, and all the symptoms subside. The patient is free from all evidence of disease for weeks, months, or years. Later, an exposure, overwork, or some other debilitating condition is suffered by the patient. The ear becomes painful, the germs in the residue within the antrum or mastoid cells left from the former attack come to life. Otorrhea sets in again. This time the outer wall of the mastoid resists distension. The tegmen tympani gives away. A collection of pus appears extradurally. The intoxication symptoms come on as before, but added to them are symptoms of compression of the brain. The pupil on the affected side is dilated. The face, arm, or leg upon the opposite side loses more or less the power of voluntary motion. The pulse gradually falls in spite of the pyrexia. Respirations are slow. The patient is hardly conscious. The only possibility of spontaneous cure lies in the complete destruction of the tegmen tympani and the discharge of the abscess through the middle ear and the external auditory meatus. Such a termination is hardly to be thought of. More often the dura is invaded by leucocytes containing bacteria, or a small vein becomes filled with an infected thrombus. This vein enters the brain substance. It is surrounded by an area of infection. If the vessel lies in the arachnoid spaces it gives rise to a meningitis which extends from the surface of the brain to the end of the spinal canal. The patient suffers from a terrible rigor, and a few hours ends the scene. If the infection extends

into the substance of the brain, or if the dura covering the abscess has attached itself to the brain by an obliterating meningitis, then a suppuration appears about the vessel wall with all the symptoms of brain abscess. Such an extension may be single or multiple; it may be diffused or circumscribed; it may produce general symptoms, or it may give rise to localizing symptoms, or both of these together.

In the place of any or all of these extensions outside the petrosa, and in connection with any or all of them, the disease may show itself by extension of the inflammatory process into the sigmoid groove and into the sheath of the sigmoid sinus. Then there results a thrombosis of the sigmoid sinus which soon becomes infected from the sheath of the blood vessel. This infected thrombus is an obliterating, advancing, infectious thrombus. The abscess appears in the neck; it is opened, or opens itself in the pharynx or along the gums or through the skin under the jaw. Pieces of the thrombus become detached, and are carried though the jugular vein and heart into the lungs, resulting in gangrene or abscesses of the lungs from the infected emboli. During the course of this disease each advance of the infection is manifested by rigors, pyrexia, leucocytosis, and by a flood of albumen in the urine.

Or, again, the disease takes a more chronic course. The antrum alone remains the site of infection, which drains readily and completely through the middle ear, the ruptured membrane and the external meatus, or through the Eustachian tube, or by both these routes. In this way the disease continues for years while the

antrum becomes filled with a cholesteatoma. This mass grows larger year by year, and the antrum, at the expense of the surrounding bone, grows to accommodate it. At last it breaks through by pressure atrophy into the extradural space and an intracranial suppuration is set up. Occasionally this process has been going on for years without the patient's knowledge, and only at the postmortem, or when symptoms of brain abscess come on, is the condition discovered.

ANATOMY

Before considering the treatment of otitis media, or what might be called disease of the antrum, the student ought to make a careful study of certain parts, at least, of the anatomy of the temporal bone and middle ear. This study should be prosecuted after a careful study of the ear of the healthy living person by all the means which are ordinarily at hand in the office of the aurist. He should then study the anatomy as related in the text-books with the carefully sawed or otherwise prepared temporal bone in his hand, and the whole skull open before him.

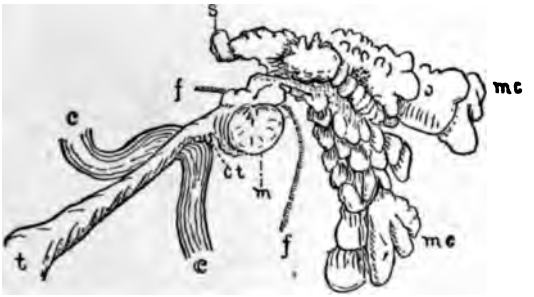
There are a number of points in the minute anatomy of the middle ear that are of great importance in understanding the etiology, pathology, course, and termination of middle-ear disease. Beginning with the tube, we find that it is a collapsed, somewhat spiral canal, lined throughout with mucous membrane. It is funnel-shaped and more rigid where it leaves the posterior nares, and is partially surrounded by cartilage during the first two-thirds of its length. The upper third is narrower and is surrounded by bone.

The tube is lined by a columnar ciliated epithelium, which is shorter in the bony than in the cartilaginous portion. Beneath this mucous membrane there is a little connective tissue only in the bony portion, while in the cartilaginous portion there is a thick layer of adenoid tissue which has been called by Gerlach and Teutleben the Eustachian tonsil. It is similar to the adenoid tissue of the nose, pharynx, and esophagus. It appears both as crypts and as lymph nodules like those in the posterior nares, though much smaller. This latter form is more common in children, while the former appears in adults. In the adenoid tissue and just below it are scattered mucous glands forming a mucous layer. These mucous glands are seldom found in the bony portion, and then in very small number.

When distended, the form of the tube is funnel-shaped, somewhat spiral, and quite irregular, especially in the bony portion. It is narrowest at the isthmus, which is located at the junction of the bony and the cartilaginous portions. In the bony portion there are frequently found considerable distensions of the wall of the tube into air cells similar to those on the opposite side of the middle ear. These cellulæ tubariæ have great pathologic significance. They are difficult to find in the fresh specimen, and in infants. In the adult they sometimes attain considerable dimensions. The bony wall of the tube lies on its median side close to the carotid canal, and when these cells fill this space they stand ready to carry infection and destruction to the wall of the carotid, and death has thus resulted in tuberculous otitis media from uncontrollable hemorrhage. The accompanying figure from

Siebenmann (Mittelohr und Labyrinth, aus Handbuchs der Anatomie des Menchen; Ed. von Bardeleben, Jena, 1898, p. 238) shows such a cell reaching around the carotid canal.

Three muscles lie about the Eustachian tube to open it in different portions. They are of surgical interest in that disease often destroys their function,



66. Schematic drawing of a corrosion preparation of the right ear, after Siebenmann. t is the pharyngeal opening of the tube. c c, the carotid. c t, cellulæ tubariæ. m, membranæ tympani. f f, facial nerve. s, squamosal cells. m c, mastoid cells.

and further in that congenital absence of these muscles, or other loss of function, promotes infection of the ear or retraction of the drum-head.

In adults the Eustachian tube is from 34 to 40 mm. long; an average of 36 mm., or an inch and a half. The mouth of the Eustachian tube can be seen in some adults through the posterior nares, surrounded by a sort of rim or nipple. It is narrowest at the isthmus, 1½ to 4 mm. in diameter, and broadest at the pharynx, where it is 9 mm. high by 5 mm. broad. The tympanic opening is from 3 to 6 mm. in diameter.

It is probable that the tube is designed to carry air

to and from the middle ear, and keep up an equilibrium between it and the surrounding atmosphere. It is more than likely that it has other functions, such as removing detritus from the auditory apparatus.

The tube of the new born differs slightly from the adult, but almost entirely in its bony and cartilaginous wall. At nine months it has approached the adult type. Congenital malformations of the tube are rarely

67. Eustachian tube of a nine-months-old child. c, tube. d, a tube cell. a, attic. b, antrum. (After a corrosion preparation by Siebenmann.)

noticed, and those that have been noticed have been in connection with cleft palate and complete fissure of the maxilla.

The middle ear is a cavity to which the Eustachian tube is attached. It is in the form of a cylinder, the axis of which extends from the middle of the drum-head backward, inward, and upward. The various sides of the middle ear are distinguished as the anterior, the posterior, the upper or the roof, and the lower or the floor. The other two walls are the membrana tympani laterally, and the labyrinthine wall medially. The anterior wall corresponds to the entrance of the tube. The long axis of the cylinder measures 1.3 cm. It is 4 mm. broad above, and a little

less when measured on the floor. The height is about 12 mm. The lateral wall of the middle ear is partly bony, but consists chiefly of the membrana tympani. The floor is separated by a thin plate of bone from the jugular fossa behind and the carotid in front. The anterior upper portion of the middle ear is occupied by the ossicles. The unoccupied portion is called the tympanic attic. This opens into the mastoid antrum by an irregular, though somewhat triangular, passage called the atrium. There are, however, in many cases, accessory openings leading directly into the mastoid cells. The roof of the middle ear, called the tegmen tympani, is very thin and laterally it ends in the young in the petro-squamosal suture. This bony roof is perforated by several minute foramina transmitting veins to the petrosal and sigmoid sinuses. These veins are often greatly enlarged in the progress of middle-ear disease. The walls of the middle ear are covered with a mucous membrane continuous with that of the attic, antrum and mastoid cells, and of a nature quite different from that of the tube and cellulæ tubariæ. The floor of the tympanum, the anterior and median walls, are for the most part covered with columnar and cuboidal ciliated epithelium, but the rest of the middle ear, the attic, the folds of mucous membrane covering the ossicles, the atrium, the inner surface of the tympanic membrane, and the mastoid cells are covered with flat, nonciliated epithelium.

The important structures in close proximity to the middle ear are naturally of the greatest importance to the surgeon. The internal ear lies directly beyond the median wall, separated only by the thin mucous

membrane and the thinner bony covering of the cochlea. This bony wall has numerous perforations for transmission of nerves to the internal or true ear. These perforations also transmit blood vessels and lymph channels. The principal blood supply of the inner ear passes through the median wall of the tympa-

68. Section through the temporal bone, showing the internal carotid artery (c), lying in the cavernous sinus, and surrounded by the network of the plexus venosus (p). t, the inferior tympanic artery; a, the atlas; j, the jugular fossa; m, the mastoid, with its cells; l. c., the longus capitis muscle.

num. Just within this median wall the first or horizontal portion of the Fallopian aqueduct turns at an acute angle and runs in an oblique direction backward (dorsally), downwards (caudally), and outwards (laterally) along the lamina cribrosa. At a level with the floor of the tympanum the Fallopian aqueduct, with the facial nerve inclosed, makes an obtuse turn downward (caudally) and pursues an almost straight course to its exit from the styloid foramen. The total maximum distance of this portion of the nerve from the

antrum is less than three millimeters. In children this nerve is covered only by a thin membrane which later in life becomes a bony wall. In many adults, however, the nerve remains uncovered for a short distance. This anomaly is probably due to arrest of development.

The proximity of the carotid canal to the floor and anterior wall of the middle ear, and the proximity of the sigmoid sinus to the median and posterior (dorsal) portion of the mastoid cells, must always be remembered during the progress of a surgical operation in the temporal bone.

69. The left middle ear and its appendages, viewed from the medial side. a, cells of the floor of the tympanic cavity. b, fissure marking the articulation of the stapes. c, an isolated cell on the posterior wall of the tympanic cavity. d f, large terminal cells. (After a corrosion preparation by Siebenmann.)

The mastoid antrum lies behind the aqueductus Fallopii and the facial nerve. It is connected with the attic by the atrium. It is kidney-shaped, and its median border lies in close proximity to the facial nerve. In children it is almost the only representative of the pneumatic sinuses of the middle ear. It measures about 12 by 8 by 8.5 mm. As the sinuses increase with age they form at least two distinct systems: the mastoid system, which is frequently in three or more directly or indirectly connected systems filling the whole mastoid portion of the temporal bone; and the squamous system, which fills the smaller cavities in the squamosa, the root of the zygoma, and some-

times the roof of the bony wall of the middle ear. An idea of the extent of these pneumatic sinuses can best be obtained by a study of the metallic casts made after Siebenmann's method (Mittelohr und Labyrinth, Von Bardeleben's Handbuchs der Anatomie des Menschen, p. 203, and Die Korrosions-Anatomie des knochernen Labyrinthes des menschlichen Ohres, Wiesbaden, 1890, quarto, pp. 7 et seq.). The extent of the mastoid cells varies greatly in different individuals, and they increase in extent from infancy to middle life. The bony walls bounding the various systems become gradually thinner and thinner until they frequently disappear between the cells of two adjoining systems. These bony walls transmit a rich and extensive blood and lymph system which is connected directly with those on the inside of the skull, and with those in the scalp and the base of the skull. When we consider the mucous lining of these cells, and the extent to which they are disseminated in the mastoid, the squamosa, and the petrosa itself, we can then recognize the tremendous difficulties which attend any effort to relieve suppurative disease in the antrum, and one or more of these systems of pneumatic sinuses; and when we consider the proximity of the mastoid systems to the sigmoid groove and sigmoid sinus, and the proximity of the squamosal systems to the middle fossa of the skull and the carotid canal, we can appreciate the

70. Bony, vascular canals between the pneumatic cells, lying upon them and communicating with their hollow interiors. (Corrosion preparation after Siebenmann.)

tremendous danger which attends suppuration or tuberculous disease in the pneumatic sinuses of the ear and the adjoining bone.

THE EXAMINATION OF THE EXTERNAL EAR AND MEMBRANA TYMPANI

All that is necessary for our purpose in the examination of the external ear and membrana tympani, is a head-band mirror, or other illuminating apparatus, and a simple speculum of metal or vulcanite adapted to the size of the meatus. Before beginning the examination the auricle should be carefully inspected for heat, redness, and swelling. The meatus itself should thoroughly be cleansed, including the removal of all wax and any long hairs that might obstruct the view, and the skin of the canal examined for furuncles, or evidence of otorrhea. The proper sized speculum should be selected and carefully introduced into the canal, under guidance of the light from the head-band mirror. During this procedure the auditory canal should be straightened by drawing the auricle upward and backward. This will cause the drum-head to be brought into view, when its anatomical or pathological condition is at once recognizable. The landmark is the whitish ridge which is the point of attachment of the handle of the malleus, and below which there appears a cone of light. The normal drum-head is of a bluish white and glistening character, but in the course of disease it becomes covered with enlarged blood-vessels, and sometimes has the appearance of a mass of granulation tissue. Ruptures and scars are easily recognized.

Other and more complicated methods of examining the drum-head are in use, but the simplest is the most available and reliable for diagnosis.

Treatment for the relief of otitis media and its sequelæ may be called for when (1) a catarrhal inflammation distends the membrana tympani, and it is necessary to incise the drum; (2) when an abscess just outside the mastoid must be opened; (3) when suppuration within the mastoid must be drained by "trephining the mastoid"; (4) when the antrum must be cleaned out or parts of its wall removed for necrosis in chronic suppuration of the middle ear; and (5) when intracranial suppuration has appeared, going out from a suppurating otitis media and resulting in extradural abscess, meningitis, sinus thrombosis, or abscess in the cerebrum or cerebellum. The first four will be considered here, and the last one under abscess of the brain and sinus thrombosis.

In order to bring the inflammation of the tympanum to an end without operation, the patient should be put to rest and kept warm. The excretions should all be promoted, and the blood pressure diminished. A hot bath and hot enema, flannel clothing and bed covering, a warm room and light diet, and clean pharynx, are all desirable. The patient must not *blow his nose* and the Politzer inflator, in spite of the instruction of our ancestors, must not be used. Dry heat or the hot water-bag to the head relieves pain, and does no harm. Opium must not be used.

Dr. Donald B. Frasier (Med. News, April 27, 1895) suffered from acute otitis media himself, and according to his best advices, used the Politzer bag and inflated

the Eustachian tube and middle ear. The ear grew worse at once. The membrana tympani ruptured with temporary relief. Then followed mastoid abscess with great pain. Wilde's incision was made with no relief. Then the mastoid was chiseled open and recovery followed. Three years later the other ear began the same way and the doctor thought he prevented its progress by aspirating the Eustachian tube and tympanum in the following manner:

He tightly closed the nostrils and mouth and attempted to fill the lungs with air, and as the air could not come from without, it came from the back of the mouth, the throat, Eustachian tube, and the tympanic cavity. By this expedient he succeeded in emptying the tube. The drum membrane seemed to bulge inward, and a collapse of the tube and cavity was produced.

1. As long as the mucous membrane lining the middle ear and its adnexa remains intact, the inflammation is called catarrhal or non-suppurative. If, however, the drainage through the Eustachian tube is impeded, the drum of the ear is greatly distended, and the patient suffers very severe pain. Then it is necessary to incise the membrana tympani. This should be done after the meatus is carefully sterilized with soap and water, alcohol, ether, and the removal of the long hairs if present. Then local anesthesia must be secured by filling the ear carefully with ten drops of a warm twenty per cent solution of cocaine. The patient must be in the recumbent position with the sick ear up to hold the cocaine solution. This must remain ten minutes, and be removed with alcohol.

The patient should now be removed to a window, or an acetylene bicycle lamp or other powerful light should be used to illuminate the ear through a speculum and a head-band mirror. As soon as the drum is brought into view, a long-handled knife, about the size of an iridectomy knife, should be used to make a curved incision in the drum. This should be done by thrusting the knife into the posterior superior quadrant, with the edge down, and withdrawing it with a little twist or rotation of the handle forward. After this operation the ear should be filled lightly with a strip of iodoform gauze for drainage, the external ear should be surrounded with cotton, and the concha filled and covered with a large absorbent dressing. Then the whole side of the head should be covered with a comfortable absorbent dressing and rubber protective. The patient should be kept in bed, his excretions promoted, and his diet limited almost entirely to liquid food. All stimulants should be denied. Only a small amount of morphine should be used as it is apt to cloud the symptoms of the progress of the disease. The external ear should be sponged off daily, or oftener, for a week or more, during which time the patient should be kept in the house and on a restricted diet. In gentle, skillful hands the nozzle of a small dropping tube or syringe may be passed into the meatus and the cavity washed out with a mild antiseptic solution. It is not, however, a procedure without danger, and must be avoided or very cautiously employed. (Charles H. Burnett, Med. News, August 17, 1895.)

Under such treatment, combined with rational treat-

ment of the nose and pharynx, from which the infection usually spreads to the middle ear, recovery follows in the majority of cases.

Dr. Charles D. Jones (Med. News, April 18, 1896) reported a case of grave appearance in which incision of the membrana tympani was followed by prompt recovery, and other typical instances can be found in the case-books of nearly every practicing physician.

A girl, eight years old, was first seen February 11, 1895. One week previous she had complained of some pain in her right ear. A few drops of choroform and tincture of opium were applied locally by a member of the family, and the discomfort soon passed away. But during the next few days she gradually fell into a comatose state. There were no particular symptoms; at least the family had noticed none. When first seen at consultation she was completely unconscious, and presented typical cerebral symptoms of grave character. She was lying on the bed with eyes closed, and took no notice of any one. Occasionally she would open her eyes and look at her father, but without giving any sign of recognition. Every few minutes she would shriek with a loud cry, most distressing to hear, and so loud that conversation could hardly be heard in the room. This cephalic cry was very marked and characteristic. At this time she had not spoken for four or five days. The temperature was normal, pulse good, bowels constipated, pupils equal and reacting normally to light. A little milk, which the nurse placed in her mouth, was swallowed.

Under ether anesthesia the right ear was examined. Occupying the site of the extreme posterior portion of

the drum was a dark red, bulging tumor. The posterior and upper surface of the adjacent wall of the external meatus was considerably congested. No involvement of the mastoid could be made out. The ear was then cleaned antiseptically and dried out, when the drum membrane was seen to occupy its normal position. It had lost its luster, and was gray and congested. The left ear was then examined. The membrana tympani looked healthy except near the posterior border; here were two or three little spots of bright red blood, which could be wiped off with the cotton probe, showing the posterior border of the membrana tympani a little congested, but not bulging. A thorough paracentesis of the tympanum was done, liberating a moderate amount of blood. No pus was seen, though a small amount could not have been detected in the presence of the hemorrhage. A small incision made in the membrane disclosed nothing. A warm antiseptic douche was applied in both ears, and calomel given in small repeated doses.

On February 12th, after recovering from the ether, she screamed but a few times, and not so badly as before. She had several hours' quiet sleep. She spoke this morning for the first time in several days, lay quietly in bed with eyes open, but seemed to take no notice of anything. Nourishment was taken freely, and the bowels had moved once. The general condition was so much improved that the ear was not inspected. On February 13th she was better, and began to talk. An inflammation began in the right ear, with some pain. This inflammation progressed to the neighboring regions and undoubtedly caused a

localized inflammation of the dura mater near the tegmen tympani.

When a case of acute catarrh of the middle ear closes the Eustachian tube it usually produces a rupture of the membrana tympani, and there is tardily accomplished what the incision of the drum-head accomplishes with less destruction of tissue. The course and treatment after spontaneous rupture are the same as after incision. In the course of ten days the inflammatory process ought to come to an end, the Eustachian tube ought to resume its function, and the incision or opening in the membrana tympani ought to be well on the road to closure. Too great importance cannot be given to absolute rest and restricted diet. The practice which some follow, of allowing these patients the liberty of the street and business as soon as the pain and temperature have subsided, is productive of chronic inflammation and otorrhea.

2. When the case comes under observation with a suppuration extending from the middle ear into the mastoid cells and penetrating the mastoid, raising the periosteum and forming a so-called subperiosteal abscess, then the simplest form of incision may be indicated. The skin and periosteum should freely be incised directly over the mastoid from a point a half-inch above, and the same distance behind, the external auditory meatus, and downward over the point of the mastoid into the neck. When the suppuration is far advanced, or the condition of the patient warrants nothing further, this simple procedure is occasionally followed by relief. The wound is kept packed with

gauze, and if the middle ear is discharging through the perforated drum-head, this must also be kept clean and dressed. The irrigation of the ear should never be left to unskillful hands and should always be conducted with the greatest care and thoroughness. The bony mastoid should always be opened and the cells thoroughly drained when it is possible to do so, even after a large paramastoid abscess has formed.

Alfred Hinde (Jour. Am. Med. Assn., August 22, 1896) reported an interesting case where a good result followed very conservative treatment:

The patient, a seventeen-year-old Irish emigrant, just arrived, had suffered for twenty-four hours with earache in the right ear. It had grown continually worse. It was attributed to a cold of three weeks' standing, and the ocean voyage. On examination, marked tenderness was elicited on pressure over the tragus and downward behind the ramus as far as the angle of the inferior maxilla. The drum membrane was intensely reddened, thickened, and its landmarks buried. The adjacent soft parts of the external auditory canal were swollen and injected, especially those of the upper posterior wall. The nasopharynx was still inflamed and discharging. The Eustachian openings were red and swollen. The ear disease was evidently an extension of the nasopharyngeal catarrh, and the grade of the inflammation was such that an accumulation of pus was expected in the tympanum as soon as sufficient time had elapsed for its formation. The symptomic treatment consisted in syringing with hot boric acid solution in large amount, and in a continuous stream into the external auditory canal; hot

fomentations of the same solution were applied to the region of the affected ear. In the absence of leeches, a fly-blister was applied over the tragus. Saline purgatives to move the bowels were advised, and for the usually increased nocturnal pain, pills of camphor and opium were ordered to be taken, one every four hours as needed. Nasal cleansing with warm salt solution was ordered. The nose and nasopharynx were daily sprayed with Dobell's solution and a eucalyptol-menthol-vaselin mixture. Besides, every second day, after cleansing the nasopharynx, a solution of nitrate of silver, one drachm to the ounce, was applied. Gentle inflation of the Eustachian tube was resorted to after a few days.

The ear pain continued, deafness increased, and a profuse serum-like discharge appeared at the external meatus; then the suffering ceased. The discharge became mucopurulent, and lastly purulent, and lessened in amount under the above treatment, and the perforation of the drum membrane decreased in size. The membrana flaccida was now seen to be bulging, and of a yellowish-red color, and on this, the thirteenth day of the disease, it was freely opened under cocaine, but the pain produced by its incision was so severe that the patient did not return for treatment for sixteen days following. During the latter time no treatment was had. She returned, however, with a complete relapse of all the inflammatory ear symptoms and a slight ear discharge. Besides, there was some headache on the right side, and slight tenderness on firm pressure over the right mastoid.

A free incision of the membrana tympani was

advised, and a crucial incision was made in its posterior half, much sanguinous pus was evacuated, and a thorough cleansing, with peroxide of hydrogen and other solutions, was resorted to. At this period of the disease the Eustachian tube could not be opened by any means whatever. The urgent symptoms decreased rapidly, and the case did well for eight days, when another relapse occurred.

The patient became pale and looked sick; the ear discharge continued; the headache and mastoid tenderness returned and increased. A slight edema and redness of the soft parts over the mastoid appeared, and an incision was suggested, but on the objection of the patient, the foregoing treatment was continued. The symptoms increased in severity. The mastoid tissues became more swollen and painful and pyrexia (101° F.) supervened, upon which latter quinine had little effect. She sickened still further, and was unable to attend to her domestic duties. During two days she vomited at intervals, and was nauseated all the time, and could not eat or sleep. An incision of the mastoid process was urged, but permission was given to cut through the soft tissues only, and this was done freely, close to the pinna, through the periosteum, and an inch in length. A small amount of thick, creamy pus was evacuated from beneath the edematous tissues, the wound was irrigated, and the bone was found to be sound and without any opening into it, and permission to open it was positively refused by the patient and her friends. The drum membrane was again incised and the parts thoroughly irrigated. After this the symptoms rapidly decreased,

and the patient was quite comfortable again for a week. The mastoid swelling and the tenderness disappeared so long as the wound remained open, but when it had almost closed she again became ill, with a complete recurrence of all the ear, mastoid, head, and stomach symptoms and fever. An opening into the affected mastoid was urgently advised, but more positively refused. A second incision through the soft tissues over the mastoid was done, and a small amount of pus again let out. The bone was not osteoporotic, but appeared perfectly healthy. No sinus was visible in the exposed field, but after a protracted search in all possible directions with a No. 6 Bowman's probe, the latter sunk into the bone through a normal canal to the depth of three-quarters of an inch, and in the upper posterior part of the mastoid process. The incision through the soft parts was now made to expose this opening into the bone. The bone was laid bare and found to be perfectly normal, and undoubtedly the passageway was a physiologic canal, giving exit most probably to an emissary mastoidal vein (emissarium mastoideum Santorini). The membrana tympani was again freely incised. Into the newly found opening in the mastoid was inserted the tip of a finely pointed, tightly tied medicine dropper, whose point diameter was 1-16 of an inch. It snugly fitted the entrance and through it was injected a dropper full of sterilized water, the drum perforation being watched at the same time. The pus was seen to ooze from the tympanum into the external auditory canal as the water disappeared from the large bulb of the medicine dropper, under extreme pressure, into the mastoid cavity!

This was repeated until the external auditory canal was filled with a watery pus and the patient felt the fluid running into the throat and coughed it out. An open way was thus demonstrated between the mastoid process and the tympanum, and through the Eustachian tube, and seeing that we had no choice, we decided to try and drain the abscess through existent openings. Irrigation was continued until clear water escaped from the ear. The relief of symptoms was almost immediate, and the patient slept well the first night, and the next day was much improved in appearance, and said she felt almost well. The head and stomach symptoms were all gone. The ear was discharging freely, and we injected a solution of peroxide of hydrogen and watched the bubbles escape through the perforated drum membrane, and the entire external canal became filled with the same, and the patient coughed the froth out of her throat and blew it out of her nose. Afterwards a one-half per cent warm solution of carbolic acid was injected, and last of all an alcoholic solution of boric acid was used, the latter causing considerable temporary pain. The mastoid wound was dressed in the usual way, and the nose and throat treatment continued. So rapid and marked an improvement resulted from the daily treatments that at the end of four days the ear discharge had almost ceased, and what little was still present was thin, pale, and watery, and seen only in the neighborhood of the perforation in the drum membrane. At the end of one week from the initial injection of the mastoid a mere speck of watery moisture at the site of the drum perforation was mopped up with cotton, and on exami-

nation per microscope, was seen to consist of a detritus, with a few granular, breaking down, and fissured pus cells. Ear treatment was now discontinued! A plug of cotton was kept in the external auditory canal, and the mastoid wound was allowed to close. In another week the tympanic perforation and the wound of the mastoid had healed, and the case was dismissed, with the request that the nasal douchings be continued. The cure was complete and proved to be permanent, as no relapse has since occurred. One year later the hearing distance for the watch was 11.40, whereas for the left ear it was 40.40, and the tuning-fork was heard in all positions better in the right ear. In all, the disease process had lasted about fifty-eight days in the right ear, but a complete and thorough drainage and antisepsis of the infected cavities had been instituted for only four to seven days before a perfect and permanent cure resulted. This is the indication in all suppurative processes, but it is notably difficult to accomplish in aural surgery without opening up freely the suppurating cavities. This case shows, however, that even as dangerous as conservative surgery is in such ominous cases, very occasionally a cure may result from simple methods.

This case is reported here at such length in order to show the course of middle-ear disease under the "let alone" treatment. The result in this case was, to be sure, unusually favorable, but this favorable result was not due in any great degree to the treatment. It is not always the most promptly and vigorously treated cases that are the most instructive. This case, for instance, furnishes many lessons of how

not to treat a patient. After opening a paramastoid abscess the most guarded prognosis must be given in relation to the course and termination of the disease. The patient or the patient's friends must be warned of the danger of recurrence. The tendency for the recurrence of the disease depends upon the fact that in any one except children the presence of a paramastoid abscess speaks for the destruction of a large part of the mucous membrane lining the mastoid cells, and frequently for necrosis of the bony walls of adjacent cells. It also promises that the mastoid antrum and adjoining cells contain detritus filled with bacteria, the residue from the infection. If the surgeon decides that a Wilde's incision is the only treatment that can be instituted he should be prepared to do a more radical operation at the next recurrence of the disease. This operation will be described in (4).

Such results as these are the rule with primary paramastoid or subperiosteal mastoid abscesses in children. In adults this form of suppuration is not so common. When it is observed, the abscess is often a long time, two to six weeks, in making its appearance. The results after treatment are not so good. The destruction of bone is usually much greater, and a sequestrum may be left behind with a permanent sinus.

Macewen (Pyogenic Infective Diseases of the Brain and Spinal Cord. Wm. Macewen, Glasgow, 1893, p. 66) gives three cases which are illustrative of the paramastoid abscess and simple incision.

Case 1. A weak child seven years old, with a tuberculous history, had otorrhea for about a year, when

severe pain in the right ear and forehead occurred. Some days after swelling arose behind and then above the right ear, which steadily increased until his admission, eight days from the onset of his illness. The appearance of nis temporal region on admission was typical. His temperature was between 100° and 101° F. His right ear hung down, the upper part being pushed outwards. The whole ear appeared to be on a lower level than its neighbor. The direction of the external auditory canal was altered. The membrane was gone, and granulation tissue presented at the orifice of the middle ear. On operation, the whole external surface of the temporal bone was found bare, the periosteum elevated, and about four ounces of pus removed from under it. The middle ear and antrum were likewise cleared out, as they were filled with granulation tissue and foul-smelling pus. He made an uninterrupted recovery.

Case 2. J. C., age eight years, was admitted June, 1890, with a history of ear disease of two months' duration, though it was probably of earlier date. Purulent otorrhea had existed for six weeks, during which there was considerable otalgia and cephalalgia. Four days prior to admission the mastoid region began to swell. He vomited once. Two days before admission he fainted, and was unconscious for ten minutes. There were no rigors reported. The membrana tympani had been perforated. Fetid otorrhea was present in small quantity. The temperature was about 101° F.

The abscess occupied the greater part of the external surface of the temporal region, though the swelling due to edema of the tissue formed a considerable mar-

gin of the periphery. The abscess was freely evacuated, and pus amounting to three and one-half ounces was found in the cellular tissue, besides what was under the periosteum. The patient was soon well.

Case 3. A. R., three years of age, was admitted in July, 1890. She was a weak child, and had had otorrhea when two weeks old, which had continued until four days before admission, when she was seized with otalgia and cephalalgia. Her temperature rose to 101° F., and a swelling formed behind the ear, and rapidly spread over the top of the ear and side of the head.

71. Acute subperiosteal squamo-mastoid abscess.

The whole of the external surface of the temporal bone was denuded of periosteum, saving the tip of the mastoid. Three ounces of pus were evacuated, after which the mastoid antrum and middle ear were exposed and cleansed. The patient quickly recovered.

3. It is as likely that there is a catarrhal condition in the mastoid cells as that this condition exists in the Eustachian tube. It is possible that it occurs without a coincident catarrhal inflammation of the middle ear. Given such a case as this, and obstruction of the atrium between the mastoid cells and the tympanum, and we have a condition in which it would be wise and rational to make an incision through the scalp, the periosteum, and the bony wall of the mastoid, and

drain the cells temporarily. Such a procedure has frequently been recommended, and has occasionally proved successful, but it is not a procedure which has any general application. It is impossible to know that inflammation in the mastoid is catarrhal and not suppurative. It is rare that the inflammation of the mastoid is acute and the atrium obstructed. It is a procedure of theoretical, rather than practical, importance.

4. The radical operation for suppurative disease in the region of the middle ear consists in opening the antrum and thoroughly draining or eradicating all the systems of adjoining mastoid cells. It is to be undertaken under four separate indications: (1) When there is an acute suppurative inflammation of the antrum and cells which does not drain adequately through the middle ear; (2) when there are repeated and recurring inflammations of the mastoid antrum and cells, with or without swelling over the mastoid process, or when there is a fistulous opening in the mastoid, discharging pus; (3) when there are initial symptoms of intracranial inflammation associated with chronic purulent otorrhea; and (4) when any case of chronic otorrhea, due to suppuration beyond the tympanic cavity in some of the mastoid cells, cannot be dried up by the skillful irrigation of an accomplished aurist.* About one-fourth of all the cases of chronic middle-ear disease are accompanied by the presence of cholesteatoma in the antrum which is a positive indication for the radical operation.

If physicians generally understood the terrible dan-

*For a practical discussion of the indications for operating, see *Allport, Frank*, Treatment of Chronic Otorrhea. Jour. Am. Med. Assn., March 1, 1901.

gers of chronic suppuration in the antrum they would not allow patients to run about and irrigate their own ears, or suffer it to be done by their friends, in the hope of recovery. The most serious impairment of health and mental equilibrium follows a suppuration in the antrum without any show of temperature or pain and swelling behind the ear.

When the surgeon has decided to open the mastoid, and convert this cavity and the tympanum into one easily drained cavity, he should pay particular attention to the condition of his patient. Only rarely is this operation necessary while the patient is suffering an acute attack. A careful consideration of the patient's temperature and pulse should be made. His urine should be examined repeatedly for indications of sources of danger. His red and white blood corpuscles should repeatedly be counted, and the hemoglobin estimated. The greatest care and attention should be given the character of the infection which escapes through the middle ear. The middle ear itself should be kept scrupulously clean by repeated and efficient boric acid irrigations, using a syringe which will place the water in the middle ear itself. The nose, mouth and pharynx, and the teeth should not escape careful and repeated cleansing, and the accessory sinuses of the nose should be examined for coincident infection. When the patient is suffering from debility and a temperature, typhoid and malaria should be excluded by repeated examinations of the blood, and the diazo tes of the urine. The condition of the intestinal tract, of the appendix, and gall bladder, and if the patient is a woman, of the genital tract, should not be neglected.

It is very disappointing, after so radical a procedure, to fail, on account of a coincident disease, to restore the patient to perfect health. Therefore the lungs should be examined for tuberculous disease in a most careful and efficient way before an operation for chronic middle-ear disease is undertaken. During all this preparation and examination the most scrupulous attention should be given the patient's diet and the condition of his skin. He ought to have a light, but abundant and nourishing, diet, and each day at least one full and quieting warm bath lasting ten minutes and followed by a vigorous shampoo with an hour's rest in bed. Twenty-four hours before the operation the scalp about the site of operation should be shaved for a distance of not less than three inches, and after a thorough scrubbing with soft soap and a stiff brush, or after the vigorous use of Schleich's marble soap, a wet boric acid dressing should be applied, covering the whole side of the head, ear, and face, to be removed immediately before the operation.

On the day of the operation the patient's colon should thoroughly be washed out with a large enema, and he should be allowed to have no food whatever during the twenty hours immediately preceding the anesthetic. The nose and mouth should carefully be cleansed, and the teeth scrubbed with a brush. The patient should be anesthetized by a competent anesthetizer in a room adjoining the operating room. The choice of anesthetic should be left entirely to the anesthetizer.

The special instruments necessary for this operation are gouges, chisels, and sharp spoons having a

maximum width of not more than 5 mm. Besides these, the ordinary instruments for routine operating are necessary. If assistants are scarce or incompetent it may be well to use an automatic retractor devised to hold the edges of the wound apart.

The sponges should be very small bits of gauze with the edges raveled and turned in. A large number are required to keep the field of operation free from blood. The operating-table should have a small, flat sand-bag on it to rest the head firmly over the solid end of the table.

The dangers of the operation are four in number: The first and greatest danger is that the Fallopian canal will be opened or collapsed, and the facial nerve compressed or severed. This is not only the most embarrassing but it is the most serious accident and the most difficult to avoid. It sometimes occurs during the progress of the disease and before any operation has been attempted, and occasionally occurs during an operation on account of previous destruction of the wall of the Fallopian canal and the involvement of the nerve in a mass of granulation tissue. When this is the case even sponging out the bottom of the wound is apt to result in injury or destruction of the nerve. The second danger lies in injuring the semicircular canals. These two injuries are irremediable, though not fatal. The third danger lies in opening the sigmoid groove and sigmoid sinus. This is an undesirable and unnecessary complication, and might result fatally from infection, or air embolism. The fourth danger lies in opening the cranial cavity and injuring the cerebral dura.

PLATE IV

Paralysis of the face from neglected otorrhea. Slight discharge from the left ear for 10 years. An exacerbation and permanent paralysis of the left side of the face, through destruction of the facial nerve in the petrosa. Case of Samuel Sexton. Fox, and Sturgis' Illustrations of Medicine and Surgery, 1893.

Among the complications of suppurative otitis the infection of the cellulæ tubariæ is frequent enough to demand attention. A most exaggerated case of this kind once fell into my hands. The patient was a woman sixty-two years old who had suffered from middle-ear disease since a small girl. She had repeated and severe attacks during her early womanhood. She was treated by aurists in Europe and America, but never with any permanent improvement. Ten years previous to my first observation of her, a polypus was removed from the ear with terrible hemorrhage, from which she nearly lost her life. The polypus quickly returned, and had continued to grow until it protruded from the auricle as a dark-red pulsating tumor as large as a black walnut. It was covered with a dirty, and sometimes bad-smelling, discharge. The whole ear took on an edematous swelling, resembling erysipelas, or more properly an elephantiasis, giving the patient a very gross and offensive appearance. She had been troubled for fifteen years with a peculiar form of dizzines and roaring in the ear. She was a very intellectual woman, and naturally sought company, but the condition of her ear had caused her to avoid seeing any except the members of her own family. Her arteries were young and soft, and she had no lesion of the heart or kidneys. After a slight recurrence of the disease in the antrum I persuaded her to allow me to do the radical operation and remove the polypus. With the assistance of Dr. Melville Hardie, and under chloroform anesthesia, which was easily borne, I opened the antrum and removed a cholesteatoma of large size which obliterated the

squamous and mastoid cells, and at the last moment opened the antrum into the middle ear by removing the upper posterior quadrant of its wall, and with a sharp spoon nipped off the pedicle of the tumor and packed the middle ear at once with iodoform gauze, to stop the alarming hemorrhage which followed the curette. The ear was then replaced and the upper and lower portions of the incision closed. The first dressing was done at the end of a week; the ear became dry at the end of two months, and although she still suffers from dizziness, she has had no trouble from the ear for ten years. The peculiar offensive hypertrophy and inflammation of the auricle disappeared soon after the operation, and the ear is now not noticeably larger than the other.

TOPOGRAPHY OF THE ANTRUM AND DESCRIPTION OF THE OPERATION

When the antrum is to be opened and the suppurating mastoid and squamosal cells removed, the patient should be in as good condition as possible. The head should be shaved for four or five inches around the ear. The auditory meatus should be rendered as clean as possible, and the patient's bowels and urinary tract should thoroughly be flushed out. It is better that the nutrition for a day or two before the operation should be as largely composed of liquids as possible. The instruments necessary for the operation are scalpels, artery forceps, small chisels not more than a quarter of an inch wide and three inches long, sharp spoons of the same size, with short, strong handles, chisels curved on the edge, also of small size, and a

retractor which will hold itself in place and press the edges of the wound apart (Bishop's), needles, cat-gut and silk, and a few small probes, which can be bent in any direction, made of fine wire three-tenths of a millimeter in diameter. The sponges should be small pieces of gauze with the raveled edges turned in, not larger than the meatus will easily admit. The operator should have an electric head-band illuminator or a good lamp with the larynx mirror. The head should rest on a sand-bag not too full of sand. The ear is first removed and held over on the face by means of an incision beginning a centimeter above the anterior angle of the meatus, passing backward for two centimeters, and then downward over the point of the mastoid process. The meatus is cut across as close to the bony meatus as possible. The surgeon must then find and mark out carefully the suprameatral triangle. This is formed above by the posterior root of the zygoma, anteriorly by the posterior upper quadrant of the external bony meatus and an imaginary line connecting these two, forming an equilateral triangle about seven-tenths of a centimeter on each side. Within this triangle an opening into the mastoid antrum may be made with safety. The opening should be parallel with the bony meatus, and should be deep enough to open only the lateral surface of the antrum. The depth to which the chisel and spoon may go can be determined by passing a probe, the end of which is bent to a right angle, into the meatus, through the ruptured membrane and into the antrum. This must be done very gently. The antrum will frequently be found full of detritus in the shape of a

cholesteatoma. From the antrum the mastoid cells can be traced with the probe downward to the tip of the mastoid, and the anterior surface removed with the chisel and spoons. The squamosal cells can also be traced upward over the meatus and opened in the same way. Great changes are wrought in the anatomy of the petrosa, and every step must be done with the greatest care so as to avoid the facial nerve, the sigmoid groove, and the base of the skull under the temporo-sphenoidal lobe. It is often necessary to open the cranium over the antrum when abscess is suspected. It is sometimes necessary to connect the antrum with the middle ear by enlarging the atrium externally, or laterally, and turning the skin of the meatus onto the wall of the antrum.

When the ossicles are covered with granulations it is sometimes necessary to remove them in the course of a mastoid operation, and put an end to infection in the attic and middle ear. The stapes should be left behind and the malleus and incus removed with the sharp spoons.

When the antrum is thoroughly opened, and the mastoid and squamous cells have been obliterated, the cavity thus formed is of great extent; it should be covered with iodoform gauze cut in small strips, and the ear should be brought accurately back into place. The gauze should be brought out of the incision over the mastoid, and the upper transverse portion of the incision should be closed anteriorly with deep and superficial stitches. The lateral or longitudinal portion should be left open. The meatus and the middle ear itself, when it is operated upon, should be filled

lightly with fine wicks of iodoform gauze. In children the use of iodoform may be undesirable, and a milder antiseptic used in its place. In the course of two or three days, when all the hemorrhage has been stopped and the opened surfaces become dry, the gauze may be removed and the skin flaps turned in so as to canalize the opening in the mastoid. The canal gives free drainage, and the base of the wound becomes covered in a few days or weeks with granulations of skin which ultimately cover the bone and render the surfaces dry and clean. When large, irregular openings have been found or made in the mastoid, it is sometimes necessary to transplant pieces of skin into these cavities in order to close them rapidly.

After operation on the mastoid there is sometimes an escape of cerebro-spinal fluid for a long time. This does not produce any unfavorable symptoms as may be seen from this history:

Lucas (Berl. clin. Wochenschr., August 2, 1899).

The patient was a young man of seventeen years, who had suffered from inflammation of the middle ear on the right side, necessitating mastoid trephining. A subdural abscess was found. The ear trouble persisted, though greatly relieved by local treatment, especially the removal of adenoid vegetations, and after the lapse of ten months radical intervention was undertaken. On opening the mastoid process a defect in the bone, filled by a sequestrum rather less than half an inch in diameter, was found, and upon its removal the dura was exposed. An opening was found in the dura and arachnoid from which blood and cerebro-spinal fluid escaped in large amount, in spite of

tamponade of the wound. The discharge of fluid continued for five weeks—quite freely for two weeks—and then gradually subsided. During all this time no cerebral manifestations appeared, and neither vertigo nor fever was present, and the pulse was normal. The abundance and persistence of the discharge in this instance are attributed to excessive production of cerebro-spinal fluid in consequence of irritation induced by the presence of the sequestrum of bone.

CHAPTER IX

ABSCESS OF THE BRAIN OF OTIC ORIGIN

Frequency, relative to sinus thrombosis and meningitis, following acute and chronic disease; complications. Relation to middle ear disease. Symptoms; initial stage; second stage; terminal stage. Diagnosis; differential diagnosis; localization.

It is certain that the surgeon is called upon more often to treat abscesses of the brain arising from middle-ear diseases than from all other causes put together. This does not, however, mean that it is so much in the majority. According to Pitt, in 9,000 autopsies there were 56 abscesses of the brain, 18 of which were from middle-ear diseases, and 9 traumatic. In Treital's 6,000 autopsies there were 21 brain abscesses, 7 of otic origin. According to Barker, two to two and one-half per cent of cases of middle-ear cases in the London clinics terminate fatally from abscess of the brain, sinus thrombosis, or meningitis. Gowers finds in 241 cases of abscess of the brain, forty-two per cent due to otic disease, twenty-four per cent to traumatism, and fifteen per cent to metastatic processes. Meyer found in 19 cases of brain abscess only 9 from otitis. Allen Starr found in 55 cases 24 from middle-ear disease. Gull and Sutton, Ball and Krishaber, found otitis media, or mastoiditis, responsible for about one-third of all cases of abscess of the

brain, while von Bergmann estimates that half of all brain abscesses are from ear diseases.

The frequency of brain abscess of otic origin to other resulting conditions is about as follows: Brain abscesses, 61 cases; sinus thrombosis, 63 cases; meningitis, 46 cases. According to Chaurel, in 1,137 cases of otitis suppurativa there appeared 1 case of meningitis, 2 cases of brain abscess, 2 cases of sinus thrombosis, and 5 cases of pyemia; while in 184 cases of intracranial suppuration (exclusive of meningitis) observed by Jansen, in the Berlin clinic, there were 144 cases of extradural abscess, 55 cases of sinus thrombosis, and 5 abscesses of the brain. Körner collected 115 fatal cases of intracranial suppuration following otitis. In 41 there was sinus thrombosis and pyemia, in 43 there was abscess of the brain, and in 31 meningitis alone. Extradural abscess alone, which so rarely is the cause of death, does not get mentioned. In Pitt's 9,000 autopsies there were 18 abscesses of the brain of otic origin, 22 cases of sinus thrombosis, and 28 cases of meningitis, both from the same source.

As a rule, abscess of the brain follows *chronic* suppuration in the middle ear or mastoid, rather than the *acute* disease. Grunert estimates the frequency at ninety-one per cent after chronic disease, and nine per cent after acute disease. When considered from the standpoint of probable brain abscess in acute and chronic middle-ear disease, the result of Jansen's statistics is suggestive. In 2,650 cases of acute otitis media there followed 1 brain abscess, and in 2,500 cases of the chronic disease there were 6 cases of

brain abscess. In the epidemic of influenza in 1891-1893 the number of brain abscesses following acute otitis was greatly increased. Eulenstein collected 18 cases. In a few cases the abscess of the brain appears after the ear seems to have recovered, and such cases are erroneously reported as idiopathic.

The abscess sometimes appears very soon after the ear disease, and in other cases as late as twenty days or a month after the onset of the acute otitis.

Although the abscess is usually the result of a perfectly natural extension of the infection from the petrosa, it is sometimes aided by the attempts of physicians to remove granulations, polypi, or dead bone from the ear, or by simple irrigation.* Virchow concludes that one-fourth of all fatal intracranial disease of otic origin is due to the presence of cholesteatoma in the antrum. All observers and authors agree that brain abscess of otic origin, like the primary disease itself, is two or three times more frequent in males than in females.

The symptoms of abscess of the brain depend (1) upon the location, and (2) upon the character and rapidity of the infection. Abscess of the brain usually follows a meningitis, and is frequently accompanied by it, the symptoms of which may obscure the symptoms of abscess. The symptoms of abscess are best considered in three stages.

In the initial stage pain is the principal symptom. It usually begins in the ear itself, but soon extends over the area of the temporal bone. After the first

* C. W. Richardson (Jour. Am. Med. Assn., Nov. 30, 1889) reports three cases of infection of the middle ear by the use of sprays, from an atomizer.

twenty-four hours, although the pain remains localized in this region, it radiates out into the frontal and occipital regions. Even when the abscess is located in the cerebellum the pain is frequently referred to the forehead. The pain is usually so severe that the patient rolls about and cries in agony. Sometimes there are violent neuralgic pains extending over the distribution of one or more branches of the fifth nerve.

Vomiting, frequently unaccompanied by nausea, is a common symptom, and has nothing whatever to do with the presence of food in the stomach.

A chill or rigor is one of the most constant of the early symptoms. It varies in intensity from a mere feeling of chilliness to the most violent and uncontrollable shivering. The history of the chill is sometimes difficult to obtain. Cutis anserina is sometimes remembered or noticed when other symptoms are overlooked. Occasionally the rigor is so severe that it is looked on by the patient's friends as convulsion. Uncomplicated cerebral abscess usually presents only one chill, while repeated chills are characteristic of sigmoid sinus thrombosis.

The temperature during the preliminary period is rarely observed, but in the few cases in which a reliable record has been preserved, the temperature was only slightly above normal. The pulse is accelerated, and the tongue coated and furred. The patient is usually moderately prostrated, and complains of pains in the legs and back.

The secretion of pus from the middle ear usually stops with the onset of these symptoms, or is greatly diminished in quantity. There are cases in which

there is no history of middle-ear disease, and in which the tympanum is unruptured. Frequently the patients give a history of a previous similar attack which passed off in a day or two upon the reappearance of the otorrhea, and therefore they are not likely to be so much alarmed as the physician. It is often possible to get a history of exposure to cold, or some injury of the head, as the likely cause of the attack, but more often there is no assignable cause.

It must not be forgotten that these symptoms described above frequently appear in the course of middle-ear disease without any intracranial localization of the infection; and on the other hand, abscess of the brain appears in a most advanced condition without any of these symptoms. The whole initial manifestation seems to have been lacking or is overlooked.

The initial stage lasts from about twenty-four hours to four or five days.

The second stage is characterized by a blunting of the patient's senses and sensibilities. The pain, which was so severe in the first stage of the disease, gradually diminishes. The patient may still complain of pain over the ear and head, but it is no longer so acute. He lies with his hand protecting his ear, and when let alone dozes quietly.

Pressure and percussion over the affected temporal bone usually produce pain and wincing, though this is not the case when the same pressure is made on the opposite side of the head. If the abscess is accompanied by sinus thrombosis, the patient complains of stiffness of the neck.

Owing to slow cerebration the patient does not at once answer a question, as an ordinary person would. He pauses and looks vacantly forward, and then, just as the question is about to be repeated, he answers slowly, briefly, and as a rule, correctly. There is a marked want of sustained attention, and at last even short questions are answered in monosyllables. If long questions are asked the patient goes to sleep before they are finished. When he asks for a drink he frequently falls asleep before he has time to taste the liquid. This pathological sleep, however, is never sound, and is never refreshing.

The patient's strength diminishes with his intellectual energy. He is unable to give more than a slight grip. All these symptoms resemble opium poisoning, but opium poisoning passes off in a few hours. The pulse and respiration are depressed, the temperature is generally about normal, or slightly sub-normal. It varies between 97° and 99° F. This is in marked contrast to the high temperature of sinus thrombosis. If the abscess is opened, the temperature rises quickly to 100° F. or over, and then rapidly falls.

The pulse varies in most cases from forty to sixty per minute. It is usually full, though sometimes weak and soft. This slow pulse is common to encephalitis and tumor of the brain, and it is also found when there is excessive intracranial pressure from depressed fracture, or from extradural hemorrhage.

The respirations are usually slow and regular. They are relatively slower in cerebellar abscesses than in cerebral abscesses. Sometimes Cheyne-Stokes breathing is observed.

Constipation is the rule in abscess of the brain, and is often very obstinate. In this respect it differs from sinus thrombosis, in which diarrhea is the rule. The urine is sometimes retained, or after the bladder has been neglected, it dribbles away in over-distension.

Vomiting is not usually observed in this stage except when the patient insists on rising and walking about. If vomiting does persist during the second stage it is probable that the abscess is in the cerebellum.

Convulsions are not common in cerebral abscess. When they do occur they may be useful in localizing the abscess.

Complete .or partial paralysis is a relatively common symptom when the abscess destroys one of the motor areas. It is of the greatest importance in diagnosing the seat of the disease. When the abscess is in the left middle lobe aphasia may precede or follow face and arm paralysis.

The color of the face has been described as grayish, but usually as very pale, in contradistinction to the grayish earthy color of infective thrombosis, or the yellowish hue of pyemia. The color of the face, however, is not positive enough to be diagnostic. The expression of the face is passive and mechanical, and even apparent smiles are meaningless or laughable.

The breath frequently has a putrid odor in abscess of the brain, and exactly resembles the odor coming from the suppurating ear, and this is the case even after the most careful and thorough cleansing of the mouth. The patients themselves frequently complain of this odor, and of a nasty taste in the mouth. But

the same symptom appears in suppurative sinus thrombosis, and is very pronounced when infarcts have occurred in the lungs, both before and after putrid expectoration appears.

Chills are not observed during the second stage in uncomplicated abscess of the brain, but they do occur whenever a fresh focus localizes itself, and when the abscess breaks or leaks into the ventricles, or into the subdural spaces. This symptom distinguishes sharply between abscesses of the brain and sinus thrombosis. During the whole course of the latter disease, chills occur every day or two, followed by sweats, and they increase in severity and frequency toward the fatal end.

Emaciation is the rule toward the latter portion of the second stage, and when accompanied by low temperature and constipation, it has a diagnostic value. When, on the other hand, emaciation follows a septic temperature with repeated rigors, sweats, and diarrhea, it speaks for infective sinus thrombosis.

Muscular trembling and myoidema are present in cerebral abscess as well as in other wasting diseases, but they have no diagnostic significance.

Optic neuritis is present in the latter part of the second stage of cerebral abscess of large size. Optic neuritis itself is of too slow development to be seen in any but the most chronic cases, and it frequently persists for a long time after the successful evacuation of the abscess. It is rarely followed in such cases by atrophy of the retina. Optic neuritis, it must be remembered, is a symptom of meningitis, tumor of the brain, and even of suppuration in the middle ear, and it is present in chronic albuminuria.

The aural examination usually discovers a perforated membrana tympani with protruding granulation tissue. Occasionally an erosion in the tegmen has been detected.

Swelling and redness over the mastoid rarely appears with abscess of the brain in adults. When it is present it has no diagnostic significance. Tenderness on percussion over the mastoid is less pronounced in abscess of the brain than in sinus thrombosis.

It must not be forgotten that the second stage does not always follow the initial stage immediately, but there may be intervals of quiescence, lasting weeks or months, before the symptoms of the second stage or the terminal stage begin. When the second stage appears it usually lasts from three or four days to several weeks, when it rapidly merges into the terminal stage. This stage is frequently termed the latent period. It is during this time that most abscesses of the brain come to the attention of the surgeon.

When the disease is allowed to run an uninterrupted course it ends in death. The disease terminates in two ways:

(1) By gradual deepening stupor and coma, asthenia, and (2) by a train of symptoms that indicate an oozing of the pus from the abscess into the ventricles or the subdural space—general meningitis. This may occur by a transportation of the microbes from the abscess to the cerebro-spinal lake without an actual rupture of the abscess wall. The event is characterized by vomiting, restlessness, temporary squinting, flushing, spasm of the limbs, trepidation, rapid pulse, hurried breathing, rigors, and high temperature.

These changes are frequently terribly sudden; the temperature rises from the subnormal to 104° or 105° F. in an hour, and the patient is seized with convulsions, quickly followed by coma and death. The whole of this stage may be gone through within five or six hours, or it may last several days.

There are some cases of apparently natural cure. The abscess becomes surrounded by a fibrous capsule and remains dormant for years. This method of cure had been repeatedly suggested as a possibility, but no case was forthcoming until Rose (Langenbeck's Archiv. für klinische Chirurgie Bd. 27, p. 529) published a case in which Wilms made a diagnosis of otic abscess. The patient, who was a child, recovered. Many years afterward the patient died of pneumonia. The post-mortem examination revealed five cavities in the brain, the remains of multiple abscesses. These cavities were lined with a thick connective tissue membrane, and filled, one with a serous fluid, and others with cheesy matter. Gowers mentions a case in which death occurred after a latent period of twenty years. In a few cases abscesses of the brain find exit through the skull. Cerebral abscesses empty themselves rarely through the eroded tegmen tympani.

The diagnosis of abscess of the brain is easy enough in a great number of typical cases, uncomplicated by any considerable show of meningitis, or by sinus thrombosis, or remote perplexing symptoms. But in the great majority of cases the diagnosis can be made only after protracted observation and most careful exclusive diagnosis. In a number of cases the diagnosis is absolutely impossible, and the only suspicion

PLATE V

An otic abscess, from a diagrammatic drawing by Körner, Otitischen Erkrankungen des Hirns, 3d edition, 1902. L. U., R. U., left and right uncus, or cornu; L. A., R. A., left and right antrum. R. G., right sigmoid groove. L. J., R. J., left and right jugular. Ab., abscess cavity.

of brain abscess appears upon the postmortem table. von Bergmann speaks of the ease with which a diagnosis of abscess of the brain of otic origin can be made when the history of otorrhea is present, and Leube speaks of the ease with which the diagnosis of subacute and chronic abscess of the brain can, on the whole, be made. Gowers speaks of the extreme variability and frequent latency of the course of cerebral abscess which often renders its diagnosis difficult, and even impossible. Martius made a study of seventeen cases of cerebral abscess occurring in German hospitals during two years, not one of which was recognized during life. (London Lancet, January 5, 1895, p. 12.)

The diagnosis of abscess of the brain of otic origin depends upon the following groups of symptoms:

1. The recognition of the primary middle-ear disease, or a history of past otorrhea. It must be remembered, however, that middle-ear disease has been observed without rupture of the membrane, and without any symptoms that the most intelligent patient recognized. But sinus thrombosis and tumor of the brain also occur in patients suffering from middle-ear disease, the former almost as frequently as brain abscess.

2. The appearance of the symptoms which have been described as characteristic of the first and second stages of cerebral abscess, viz.: a stage of excitement and suffering, followed by a stage of depression with a low temperature, absence of chills, slow pulse, with or without the symptoms of increased intracranial pressure, absence of optic neuritis with hyperleucocytosis.

3. Symptoms localizing the abscess or lesion to some particular portion of the brain consistent with its origin.

Localizing symptoms are only occasionally found in cerebral abscess of otic origin because the majority of these abscesses are situated outside the motor area. The chief seats of abscess of otic origin are, on the one hand, in the temporo-sphenoidal lobe, and on the other hand, in the cerebellum. Abscesses of traumatic origin are in the neighborhood of the injury and are more apt to be cortical. In any of these regions an abscess may form without exhibiting localizing symptoms until it has arrived at a very large size.

Percussion and the cranial note are of some assistance, especially in children, in determining the location of a cerebral abscess. A thin cranium vibrates more readily than a thick one. The percussion is made by tapping the head with the finger, like a piano key. The amount of hair and the thickness of the scalp modify the note. Sometimes a better result is obtained by placing the ear in contact with the head of the patient, or by applying the stethoscope as in auscultatory percussion. The note assumes a duller and lower key on the side of the abscess, but it must be remembered that nearly the same effect is produced by necrosis in the petrosa.

Abscess of the brain must be differentiated from sinus thrombosis, from meningitis, from extradural abscess, from simple extension of the middle-ear disease within the temporal bone, and from epidemic cerebro-spinal meningitis occurring in a patient with otorrhea. Sometimes it is necessary to distinguish

between brain abscess and brain tumor, and the diagnosis is frequently very difficult, or even impossible. von Bergmann and many others lay great stress upon etiology and the presence of fever, but the surgeon should not put too much stress upon the presence of middle-ear disease. Hitz saw a man who had suffered for sixteen years from otorrhea, and besides had received a blow on the head, yet he died of tumor of the brain. Eskridge reports a case of cerebral disease in a little girl suffering from otorrhea, who had had an abscess in the right groin and had received a blow on the head, all possible causes of abscess, yet she died from tumor and cyst of the cerebellum. (Am. Jour. of the Med. Sciences, August and September, 1896.) While a trauma is frequently the cause of abscess of the brain, it must also be remembered that it seems capable of giving rise to tumor.

Sinus thrombosis is differentiated from abscess of the brain by repeated chills, the high and variable temperature, the stiffness of the neck, and the extension down the jugular; but it may want all these symptoms. From meningitis alone, and from cerebro-spinal meningitis, it is possible that lumbar puncture would furnish a hopeful means, but it must not be forgotten that every case of abscess of the brain must either be attended or preceded by at least a localized meningitis. In one case of cerebro-spinal meningitis which I treated myself, lumbar puncture showed the presence of the diplococci, and repeated injections of defibrinated blood taken from a patient just recovered from pneumonia was followed by relief of all the symptoms except the terrible pain and tenderness in the region

of the left mastoid, and from the history of previous disease in this ear, I was led to open the mastoid, the sigmoid groove, and the skull above the petrosa. Repeated puncture failed to discover an abscess, and the postmortem showed a simple cerebro-spinal meningitis with an almost equal distribution of the yellow lymph over the base of the brain.

In the recognition of abscess of the brain, the X-ray photograph has been of little use, though it has occasionally shown the location of unsuspected abscesses and tumors.

At the very best the diagnosis of brain abscess is uncertain, and the surgeon must be prepared for failure and disappointment at alarmingly frequent intervals.

ABSCESS OF THE BRAIN	SINUS THROMBOSIS
Prodroma — Chronic suppurative otitis media; cholesteatoma; tuberculosis of petrosa, or acute otitis media.	Almost always a chronic inflammation in the temporal bone, and especially in the lower mastoid cells.
Temperature, Etc.—Normal; subnormal or very low fever following a very slight or a very pronounced chill (rarely a higher fever), subsequent chills absent or trifling.	High remittent fever with daily remissions; repeated, almost daily chills; frequent profuse sweats; characteristic temperature: exceptionally a normal temperature.
Circulation—The pulse is slowed, the leucocytosis is increased.	The pulse is irregular and rapid, and the leucocytes are enormously increased.
Convulsions—Not frequent; sometimes in children; sometimes in place of initial chill.	Not the rule, but rather frequent, especially in children.
Headache, Vomiting, Dizziness—The first always, the others generally.	All of them generally present. The headache not so marked.
Retina—Neuritis frequent; choked disc rare.	Neuritis and choked disc frequent.
Intellect—Hebetude; coma almost invariable.	Only slightly modified in many cases, or advancing to hebetude and coma.
Strength—Very greatly diminished.	Loss of strength less conspicuous and sudden.
Focal Symptoms—Common; aphasia; hemiparesis; unilateral convulsion; hemianopsia; cerebellar ataxia, etc.	Rare; sometimes in children; unilateral convulsion.

Otic abscesses are confined more closely to the petrosa than abscesses of traumatic origin are to the scar of the infected injury. In the latter case these abscesses have been found at great distances from the scar, and even on the opposite side of the head, while otic abscesses are confined to the cerebrum on one side, and to the cerebellum on the other side, in rather close proximity to the source of infection. It is noticeable further that the same rule prevails in regard to the depth of the abscess that holds in the case of abscesses of traumatic origin. The more acute the process the more superficial the abscess, while the latter and more chronic abscesses are often found quite a distance below the cortex, and apparently separated from the infected dura by a layer of healthy gray matter. Most abscesses of otic origin are found in the middle fossa of the skull and in the temporal lobe of the brain. In Gower's general statistics there were 186 abscesses of the cerebrum, 41 of the cerebellum, 3 of the pons, and 1 of the medulla oblongata. In the more recent collection of Lazorte and Lehmann, including 458 cases, 327 were in the cerebrum, 113 in the cerebellum, while 11 were in both. Körner says that otic abscesses appear twice as often in the temporal lobe as in the cerebellum, and that in children under ten years of age, more than four-fifths of the otic abscesses are in the temporal lobe of the cerebrum. Otic abscesses are always on the same side as the affected petrosa, though there are numerous cases where both ears are affected and abscesses appear on both sides coincidently, and there are other cases in which no external evidence of disease of the

middle ear on either side is present. Of course there is no limitation as to the location of abscesses of pyemic origin springing from middle-ear disease primarily, but fortunately these cases are rare, and beyond surgical interference. Numerous authors have spoken of the greater frequency of abscess in the right hemisphere.

Brain abscess of otic origin is generally solitary. If we exclude single abscesses appearing over each petrosa, less than ten per cent have two or more foci. This corresponds with the tendency of abscesses of traumatic origin to be solitary. Macewen reckons that ninety-three per cent of traumatic and eighty-seven per cent of otic abscesses are solitary.

If we could place a hundred shot in a brain, and let each represent an otic abscess in its proper position, more than two-thirds of these would be represented in an X-ray photograph of the brain as accessible from a trephine opening three-quarters of an inch above the posterior wall of the bony meatus; most of the others would be scattered about the cerebellar lobe in close proximity to the petrosa. Therefore, when an abscess of the cerebrum is to be evacuated it is best approached from the point described. Even when the symptoms would suggest a higher or more anterior location, it is probably wise to make the exploratory incision at this point.

Usually the antrum has been opened, and this has required an incision which may be extended upward and reflected backward in order to give room for the trephine or chisel. It is very desirable to save the bony wall of the cranium, and an osteoplastic opera-

tion is best adapted to this end. It is easily accomplished with the DeVilbis instrument, as the squamous portion of the temporal bone is thin and well adapted to this method. A flap of bone and scalp an inch in diameter should be turned back and protected; the aspirator can then be used if necessary to confirm the diagnosis. Then the dura should be opened by a rather narrow slit, half an inch long, and the brain substance divided with a knife, followed by duck-beak artery forceps and a drainage tube. It is much easier and safer to introduce the tube before the abscess has completely discharged itself. The tube should be a centimeter in external diameter, and only moderately firm, with at least one fenestrum a half-inch from the end. It should remain till the first dressing is removed, when it should be replaced by a strip of iodoform gauze. After the introduction of the tube the abscess may very carefully be washed out with normal salt solution, the tube held in place by a large safety-pin on the surface of the dura, and all carefully covered by several layers of iodoform gauze, completely filling the cavity from which the flap of bone has been removed. When thus thoroughly protected, and the exit from the tube provided for, the flap of bone should be turned down and again covered with iodoform gauze, the opening into the antrum and mastoid dressed, the external auditory meatus packed, and a large external dressing put on to cover the whole side of the head. This dressing should be allowed to remain for forty-eight hours, or even longer, if the condition of the temperature, pulse, and leucocytosis warrant. When the second dressing is made, and the tube

replaced by gauze, the osteoplastic flap should be brought into place and the scalp sewed together. The subsequent care of such a case is simple, and similar to the care of a traumatic abscess of the brain, or a radical operation on the antrum.

Should the trephine be used to remove a button of bone, this can very well be preserved by dropping it into a normal salt solution and keeping it, during the operation, at the temperature of the body.

Operation for cerebellar abscess is usually prosecuted through an opening designed to expose the upper portion of the sigmoid sinus, from which the abscess usually springs. After this sinus has been thoroughly explored the abscess is often opened in the process, or it may be reached after aspiration by the introduction of a knife, or a thin-bladed elevator or knife handle, and treated the same as an abscess in the temporal lobe.

The complications of otic abscess ought to be considered separately for cerebral and for cerebellar abscess. Cerebellar abscess is almost always preceded by an extradural abscess, or by a sigmoid sinus thrombosis, or at least by a pronounced suppurative but local meningitis. This is much less frequently the case in cerebral abscess. Acute cerebral and acute cerebellar abscesses are naturally accompanied by a considerable meningitis, and they are more often complicated by extradural abscess than chronic abscesses. Hessler mentions that in 106 cerebral abscesses, 67 were uncomplicated, 13 were associated with sinus thrombosis, and 26 with meningitis; 59 cerebellar abscesses showed 43 uncomplicated cases, 10 with sinus throm-

bosis, and 6 with meningitis. It may generally be assumed that the dura and the pia in the neighborhood of the abscess are completely united, but this, in the place of being a complication, is rather of the greatest assistance in operating. When an abscess has ruptured, or is in communication through lymph channels with the cerebro-spinal lake, it is accompanied, though hardly complicated, with a general meningitis. This is a rare and a terminating condition, and precludes all operation. It has been recognized as existing, and it may be quite positively excluded by lumbar puncture. Hemorrhagic encephalitis and diffuse abscess of the brain may be looked upon as one and the same condition, or the former may be considered a complication of abscess.

Pyemia occasionally follows middle-ear disease, and it is usually preceded by a distinct sigmoid sinus thrombosis, or a thrombosis of the jugular bulb. There are, perhaps, a few cases, 3 out of Jansen's 94, in which neither the operation nor the postmortem showed sinus thrombosis of any kind.

There is nothing peculiar in the case of pyemia following ear disease, and there is no time in the course of the pyemia in which operation should not be undertaken to eradicate the primary focus of infection and remove the metastatic processes wherever they are accessible. A few cases of pyemia following ear disease have terminated favorably without operation. Operations in the course of a pyemia, opening the mastoid and the sinus, ligating the jugular vein, result unfavorably only on account of the previous dispersion of the infection. In Jansen's 50 cases,

when it was necessary to tie the jugular vein, one-fourth died and three-fourths terminated favorably with a more or less protracted suppuration.

There is nothing peculiar in the character of the infection. It is usually due to the streptococcus, but occasionally to the pneumococcus. In a very few cases Friedlander's bacillus has been found.

Tuberculous mastoiditis is also accompanied by a tuberculous metastatic process similar to pyemia.

CHAPTER X

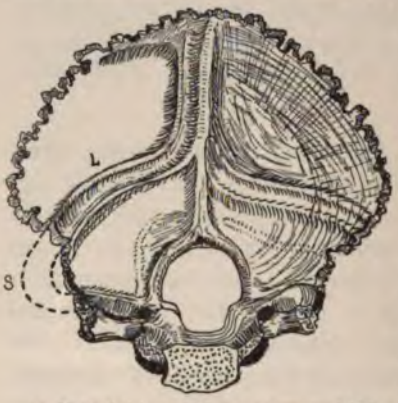
SIGMOID SINUS THROMBOSIS

Frequency; age; etiology; course; method of extension; symptoms; pyemia; examples; differential diagnosis. Extradural abscess; origin; symptoms; illustrations; adages; literature.

The most common form of grave intracranial infection, not even excepting abscess of the brain, is sigmoid sinus thrombosis. It occurs as a complication of mastoiditis, and of acute disease, while brain abscess usually follows chronic disease. It is accompanied or preceded by meningitis, and often by extradural abscess. Its pathology, course, and symptoms have frequently been referred to in discussing brain abscess, but a few points ought to be considered here by themselves.

In frequency it probably equals or exceeds abscess of the brain of otic origin. It is more common in children and in first attacks, and in acute attacks even when recurring, than it is in adults and in subchronic or chronic disease. In infants it is seldom seen, because the mastoid cells outside the antrum are yet undeveloped, and because the union between the squamous and the mastoid portions of the temporal bone has not yet become solid. The purulent matter, therefore, finds a ready exit and produces paramastoid abscess.

The thrombus forms on the wall of the vein next to the sigmoid groove. Its origin is easy to comprehend when we consider the acute inflammation in the mastoid cells in close contact with the sigmoid groove. The infection destroys the wall of the sigmoid groove, and forms an extradural lake of pus in direct contact with the periosteum, which has been raised from the groove, and in direct contact with the wall of the vein. This periosteum, and even the wall of the vein, are destroyed by the infection, and the destruction is preceded by a protective thrombus within the vein. This thrombus soon obliterates the vein, and when the last remnants of the vessel wall give way before the virulency of the infection, the thrombus itself is invaded by the micro-organism, and in its central portion becomes a lake of pus. Or, if the wall of the sigmoid groove persists, the thrombus may be formed by the advance of the infection into the interior of the skull through the aid of small advancing infected thrombi in the blood vessels of the bone itself, and thus the sigmoid groove may be filled with a lake of pus. Or, barring both these methods of infection, the lymph



72. Occipital bone, showing course of (L) lateral, and (S) sigmoid sinuses.

spaces remain, and they are the natural channels for the diffusion of infectious germs. The distance between the pus in the mastoid cells and the wall of the sinus is trifling. The pressure within the mastoid cells is great, and it is natural to suppose that the lymph channels are forced to carry streams inward. The current may be so rapid that living micro-organisms are brought in contact with the edematous lining of the sigmoid groove. Here they set up a destructive process, and produce a focus of intracranial infection, which results in sinus thrombosis. It is probable that in any given case more than one of these sources of infection is present. The history is the same.

The symptoms of sinus thrombosis are fairly distinct, and a diagnosis may be made by them in a considerable number of cases. An acute mastoiditis exists which began not many days before the symptoms of thrombosis set in, but after the beginning of sinus thrombosis, the mastoid symptoms may be entirely relieved. In a very few cases evidence of mastoid disease is not at hand. The temperature, pulse, and respirations are those of acute sepsis; chills, rise of temperature, and sweats are of almost daily occurrence. The face takes on a dusky, almost jaundiced, hue. Diarrhea is apt to prevail. The appetite is poor, but not wanting. The intellect frequently, during the remission of temperature, is almost normal. Convulsions rarely appear, except in children at the height of the fever, or in adults in the very end of the disease. The neck is usually stiff, and the whole paramastoid region tender, and a peculiar tenderness is felt in the neck just below the angle of the jaw. As

the disease progresses farther the lymph glands in the neck become enlarged, and the tissues about the jugular vein are infiltrated. In this region abscess occasionally appears, and when opened it contains dark pus with blood crystals. Later still abscesses appear in the lungs. They are usually multiple, and are a terminal symptom of the disease.

It is probable that the sigmoid sinus may become partially or completely obliterated by a protective and noninfected thrombus without giving rise to any recognizable symptoms at all. From such a condition recovery would take place provided the mastoiditis and the extradural abscess were properly treated, and neither surgeon nor patient would know that it had existed. Infection of the petrosal sinus, and possibly of other sinuses, might give rise to sigmoid sinus thrombosis.

A few typical cases give, perhaps, a better perspective of the disease than can be obtained in any other way.

The following case, reported by one of my students from the Cook County Hospital, is very suggestive. (Clark, S. B., Postmortem demonstration of a case of pyemia, following a latent otitis media. Medical News, January 5, 1895.) The case reported occurred in a postmortem examination under Dr. Ludwig Hektoen, October 18, 1893. The patient was a man, aged twenty-one; a porter by occupation; of negative family history. He was admitted into the hospital October 1st, having been sick about three weeks; he complained of chills, fever, nose-bleed, loss of appetite, and general debility; no cause was given for the

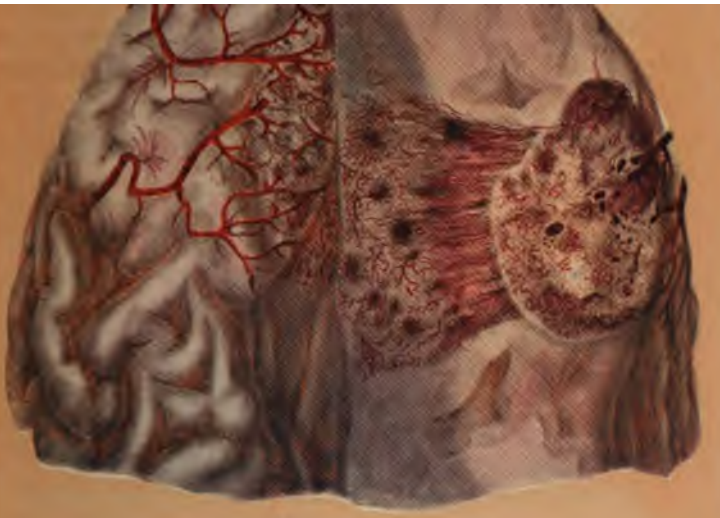


PLATE VI

SARCOMA OF THE BRAIN.—This drawing shows the location of a tumor in the anterior right cerebral hemisphere. The upper portion of the right hemisphere is cut away. The peculiar extension of the tumor and vascularization of the brain, making removal difficult or impossible, is very strikingly illustrated. Could such a tumor as this be diagnosticated, its attempted removal would be attended by the most serious difficulties, and the hemorrhage would probably be uncontrollable. It appears almost certain that metastasis has already reached beyond the field of reasonable operation. Reduced from Lebert.

sickness, and the man had previously been well. When admitted he was stupid, the skin yellowish, the tongue thick and coated; examination of the lungs and heart was negative; the spleen was not enlarged. The temperature was about normal, and the pulse slightly accelerated. On the second day after admittance he had a marked chill, and the temperature rose from 97.5° to 102°. Chills and fever continued in such irregular manner that malaria was suspected, but the result of the blood examination was negative. The pulse was generally over one hundred, and when the chills came on would rise as high as one hundred and forty or more.

On October 8th tenderness and pain developed in the right lung over the region of the mammary gland; there was dullness on percussion, and the respiratory and vocal sounds were somewhat diminished. On October 18th, the apex-beat of the heart was displaced to the left of the nipple-line one inch, in the fifth interspace, and cardiac dulness was increased. The pulse became rapid and jerky, and the patient died in an exhausted condition.

The postmortem examination revealed the following changes: The body was much emaciated; examination of the abdominal contents was negative, except that there was swelling of the mesenteric glands. The pericardium, with the heart, was compressed, and pushed toward the left side by turbid semi-solid fluid in the right pleura, held in by adhesions. The pericardium was also adherent to the left lobe, and in front the pleura was adherent to the sternum by grayish purulent masses. An opening was seen through the

left pleura, back of the sternum, that communicated with the lung.

In the left pleural cavity were weak adhesions, and a small quantity of turbid, yellowish fluid, in which were solid fibrinous masses. The heart-examination itself was negative.

The right lung showed numerous septic infarcts anteriorly where the pain had been felt. The lobes were adherent, and many yellowish softened areas, with their bases toward the pleura, were easily discernible, some of them fused together, and containing purulent material of a foul odor. This lung did not float, and when incised showed many yellowish necrotic foci.

The original cause of these many metastatic foci could not yet be accounted for, and preparation was made to examine the brain.

In the mean time, the right internal jugular vein, from its commencement at the jugular foramen to the right innominate vein, was found to be in a condition of suppurative thrombo-phlebitis, and contained a semi-solid mass of foul, viscid, purulent material from beginning to end.

After the calvarium was removed and the brain taken out, a septic focus was found in the middle ear, and another in the mastoid cells, and leading from this the veins connecting with the lateral sinus were found in a condition similar to the internal jugular.

The lateral and other sinuses of the dura mater were in a suppurative, thrombo-phlebitic condition also.

This readily explained the route of infection; down

the lateral sinus to the internal jugular vein, thence through the innominate vein, the superior vena cava and heart to the lungs.

The autopsy well illustrated how a trifling little abscess of the middle ear, so small as not to be noticed by the patient, may cause the gravest form of pyemia, and death.

Synopsis.—Rigor and high temperature beginning without apparent cause. Neuralgia of right fifth nerve for ten days. Typhoid or septic condition resembling sinus thrombosis for six weeks. Abscess appearing suddenly in the posterior right pharynx. Six weeks later discharge from the right ear, paralysis of the right leg, and death.

Necropsy.—Antrum and general mastoid disease; sigmoid and general sinus thrombosis extending into the cortex of the left hemisphere.

Dr. W. had his birth, education, and active life in the Mississippi Valley. He was a well-built man, five feet nine inches tall, of perfect physical growth and development. He had been in the active practice of medicine in a country district for the greater part of his life. He was a hearty eater, but temperate in other respects. He was the father of a large family of perfectly healthy children. He had himself suffered from no disease, except malaria and gout. The evidences of gout were present in his thin and over-aged skin, in the enlargement of his joints, in Dupuytren's contraction of the flexor tendons of the palm, and in an irritability or excitability of temper, which occasionally showed itself. I had been well acquainted with him for ten years.

On May 20, 1898, he came in from some slight

exercise out of doors after a long day's work in the office, complaining of a chilly sensation. He removed his shoes and outer garments and lay down on a lounge with a hot water-bag and a great many covers. In spite of these precautions he went into a terrible rigor, which lasted over an hour. After this he had a temperature of 104° F. and pain through the back and legs. Headache was not a noticeable symptom at the beginning. The fever continued, and at the end of forty-eight hours, general headache came on, and about four or five days after the chill it had located as a distinct neuralgia over the distribution of the *right* fifth nerve. Dr. Weller Van Hook saw him twice during this period, and found the pharynx deeply injected, hyperemic, and somewhat edematous. He believed the temperature due to an acute pharyngitis. No cultures were made from the throat. Local antiseptic treatment was instituted, but without much effect. His temperature remained high, and the pain grew worse.

Sunday morning, May 28th, he came to Chicago, and I examined him. The patient was extremely hyperesthetic, and dreadfully broken down and nervous, resembling a person in the early stages of delirium tremens. He described his symptoms and the history of his case with unnecessary picturesqueness and detail. At this time the pain over the right side of the face and scalp was intense. There was tenderness on pressure over the exit of the right supraorbital and right infraorbital nerves. The entrance of the inferior dental and the whole alveolus on the right side were exceedingly tender to pressure. The patient

complained of tenderness on the right side, deep in the neck, behind the angle of the jaw. There was no evidence of suppurative disease or obstruction in the antrum of Highmore. There was no difference in the appearance or expression of the two sides of the face, except for a slight swelling over the right parotid gland, where tincture of iodin had been repeatedly applied. Pressure upon the mastoid and hard thumps upon it elicited no pain. The hearing was perfect in both ears. The question of suppurative otitis media was carefully considered. The patient himself declared that he had never suffered from earache or any difficulty with either ear. A present primary catarrhal otitis media was excluded by the good condition of the hearing, absence of any discharge from the ear, the absence of pain or earache, and the normal appearance of the drum-head. The diagnosis seemed to rest between a neuralgia with malaria and an osteomyelitis of uncertain origin at the base of the skull, possibly from one of the sinuses of the nose. Antimalarial treatment was instituted, with laxatives and diuretics to counteract the influence of morphia, which had been necessary to relieve the pain.

After some slight improvement the patient returned to his home feeling better. The temperature continued above normal, but the pain in the face gradually subsided.

On July 10th he entered the Polyclinic Hospital with a high temperature, rapid pulse, and such symptoms as led to an examination of his blood for typhoid. At this time he was carefully examined by Dr. J. B. Herrick and Dr. Weller Van Hook. There was no

pain now, and the symptoms were those of hyperpyrexia and excessive irritability. The pharynx continued red and received local treatment. At noon, on July 14th, Dr. Van Hook discovered in the right vault of the pharynx a large fluctuating tumor, which he at once recognized as an abscess. He felt certain that this tumor was not present in the morning. I saw him in the evening of the 14th, and easily opened the abscess through its thin wall between the arches of the palate and allowed about three ounces of pus of a light chocolate color to escape. The cavity was washed out repeatedly. On the following day the tongue cleared up, and the temperature became nearly normal, his appetite returned, and he decided to go home.

On July 21st, he again sent for Dr. Weller Van Hook, who found a temperature of 103°, the pharynx still red, with the appearance of another abscess, but this time *on the left side*. One or two unsuccessful attempts were made to open it. The patient was brought to Chicago and placed in the Baptist Hospital, July 22d; his temperature at this time was 102° in the rectum; the pulse was 90. His subsequent temperature and pulse are represented in the accompanying chart.

On entering the hospital, a careful examination was again made to discover the source of suppuration. The patient had lost considerable in weight and strength, but was in better mental condition than when he left the city. His hearing was good in each ear, and his sight was unimpaired. He was able to sit up each day and read the newspaper.

There was somewhat more tremor of the hands than when last seen, but his grip was equal, and not less than would be expected with his general debilitated condition. He took liquid nourishment freely, and with relish. He complained constantly of a nasty, bloody taste in his mouth. He was almost sleepless,

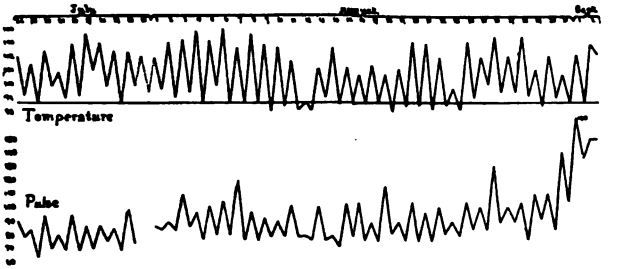


Fig. 73. Temperature and pulse record showing the highest and lowest records each day.

but not from any localized pains. His greatest pain and tenderness was over the toothless gums of his lower jaw, on the right side. There was no edema, fluctuation, nor other evidence of infection of the lower jawbone or between it and the periosteum. The whole pharynx was red, smooth, and in places edematous. In the neighborhood of these edematous places were three openings, from which bloody pus could be extracted. Swallowing was slightly painful and made a liquid diet necessary. There was no adenitis over the mastoids or about the neck. The urine was normal in amount and composition.

Each of the nostrils, orbits, and ears was separately and carefully examined. Disease was looked for unsuccessfully in both frontal and maxillary sin-

uses. The mastoids were separately examined, and the eardrums inspected, but no symptoms of disease discovered. The openings in the pharynx, seeming to give inadequate drainage, were greatly enlarged, and found to connect from the right to the left side of the fauces. In this way a very complete irrigation was possible. He liked to have forcible irrigation in spite of our fear of damage.

The throat and the open spaces behind were irrigated many times daily with all ordinary antiseptics. The short rubber syringe and the fountain-syringe were used, the former to wash out the mouth and pharynx, and the latter to irrigate the abscess-cavities. The amount of pus which came from these openings was many times larger than any one would expect from all the possible findings, but gradually diminished.

The patient complained of little chills at intervals, and vomited without apparent reason, so far as the condition of the stomach and vomited matter was concerned, on July 26th, 27th, 28th, and 29th. His temperature gradually rose, and on August 5th he complained of great and unaccountable nervousness. On that day he had the most pronounced chill since the beginning of his sickness. It was far short of a rigor. He did not read so much after this, but talked rationally, and sometimes in an animated manner. On August 6th he complained for the first time of severe pain in the head. On the 9th he vomited and was extremely nervous. On August 10th he was examined by Dr. T. Melville Hardie. His temperature was 99°, pulse 78, and he sat up in a chair for examination. Posterior rhinoscopy was easily made.

It showed nothing abnormal. Transillumination of the face showed two sides alike, not well lighted; this probably due either to thick cheeks or small antrums. Nothing abnormal by anterior rhinoscopy. Both ears were examined perfunctorily with everything apparently normal, and hearing good. No pain or tenderness in the region of the ear.

From August 5th the patient was so nervous and restless that it was necessary to give a small quantity of morphine daily. He was occasionally seen by Dr. J. B. Herrick, and I visited him twice a day, always looking for the source of infection. August 16th an abscess was opened between the lower jaw and the right side of the tongue. It communicated with the pharynx. August 25th he vomited, and had a slight chill. Temperature 102°, pulse 100. He complained of a stiff neck.

August 26th I made the following entry on the history sheet: "Opened an abscess over right lower jaw near angle. Felt thickening and edema above and behind the angle of the lower jaw *on the left side* (not the cause of high temperature). Patient complained of severe pain in left ear for a few minutes, at ten o'clock this morning. This paroxysm was preceded by several hours of discomfort and crackling in the left ear. Growing tendency to nausea on slight provocation, especially during the last two days." Again the mastoids were examined, but there was no indication of any disease. The hearing was good in both ears.

During the night of the 27th at least two drachms of dark pus were discharged *from the right ear*. This pus

came through a perforated drum-head and gave some relief to pain and nervousness. He still took a large quantity of nourishment—about two quarts of milk a day.

On the morning of August 30th the right leg was completely paralyzed below the knee. This had been coming on for four days. At 7:15 A. M. there was a convulsion, frothing at mouth, stertorous breathing, and imperceptible pulse. This convulsion lasted twenty minutes. Following this convulsion Dr. Arthur Edwards saw the patient, and confirmed the findings. There were no other localizing symptoms. The discharge from the right ear continued. The eyes, face, and tongue were normal. There was no paralysis of the arm. The sensations over the affected right leg and elsewhere were normal.

A diagnosis was made of "*localized lesion, probably abscess, in the neighborhood of motor cortical area for right leg and foot, secondary to suppuration in pharynx.*" An exploratory operation was undertaken on these imperfect indications.

During the six hours after the convulsion and before the operation the temperature was 100° and the pulse between 105 and 138. At 5 P. M., in the presence of Dr. Arthur Edwards, and after the usual preparations, the left hemisphere of the brain was approached by means of two one-inch trephine openings connected by a third. There was evidence of a little pachymeningitis at the upper border, such as we often see in old drunkards. The dura bled. The brain pulsated. The dura was opened. No leptomeningitis. The brain was systematically explored with an

aspiration needle ten cm. long and one mm. in external diameter. No result. The bone was replaced and the scalp wound closed. Skull-cap dressing. The anesthetic was given by Dr. D. H. Galloway The pulse at the beginning of the operation was 130, but during the operation it fell to 80, and at the close was 140. When the patient was placed in bed his pulse was 124. The patient did well after the operation, and the wound healed completely. He was conscious and rational the day following the operation, and inquired about members of his family and business affairs. He knew his end was near, and disposed of several affairs requiring his signature.

On September 3d he died, gradually sinking away. On the following morning the necropsy was made by Dr. Arthur Edwards. The trephine wounds had healed without suppuration. The skull-cap was moderately adherent over the longitudinal sinus. There were some flakes of pus on the convexity of the dura over the anterior portion of the sinus. The left hemisphere showed several punctate extravasations about the needle-wounds. The dura was only slightly adherent over the upper border of the left hemisphere with light fibrous exudate. The blood-vessels of the dura and pia were thrombosed over at least six cm. of the upper surface of the left hemisphere nearest the longitudinal sinus. The cut surfaces of the cortex itself had a dull, greenish white appearance. The longitudinal sinus was filled with a suppurating thrombus. There were a number of flakes of suppurating fibrin along the lateral walls of the sinus. Both lateral and both sigmoid sinuses were

full of pus and blood, the right distinctly fluid (Fig. 74). The dura over the right petrosa was adherent on the posterior surface. The jugular veins in the neck

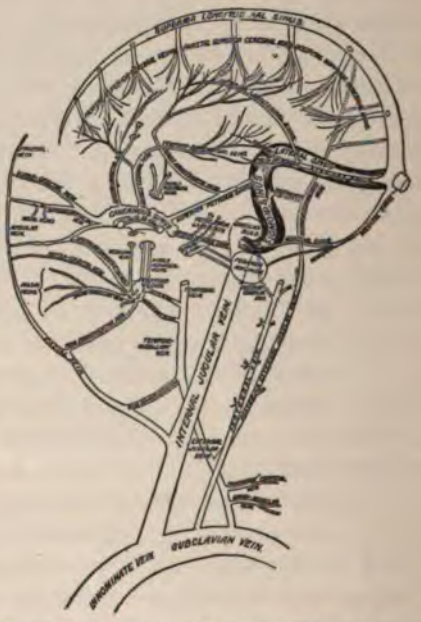


Fig. 74. The veins and sinuses of the head and ovale from Macewen.

were not examined. No indications of infection were found in the lungs, in the heart, or in the abdominal organs.

The right temporal bone was removed for more careful study, and with it portions of the surrounding bones. Subsequent examination revealed the following significant points: The external auditory meatus

exhibited little change from the normal. The drumhead persisted, and did not seem modified by infection. The mucosa lining the tympanic cavity was entire, except on the side toward the antrum. There was little or no evidence of otitis media. The sigmoid sinus lay in a deep sigmoid groove, the posterior wall of which extended downward into the completely excavated mastoid and upward into the antrum (Fig. 75). The wall of the anterior surface of the petrosa over the antrum, just posterior to the tegmen tympani, was almost perforated. The antrum opened into the middle ear, and the middle ear into the external auditory meatus, and this whole series of cavities, except the middle ear, was bounded by an eroded wall. The mastoid did not open externally. The sigmoid groove at its internal end was completely denuded of periosteum and the occipital bone was infected and eroded. The wall of the jugular bulb was thickened, and in places eroded and perforated, and everywhere its lumen nearly obliterated by thickening. Across the jugular bulb, just as the sigmoid joins it, was a band of organized material, showing that at one time a thrombus bridged it over, and was partially organized. Subsequent suppuration had never com-

75. Section of the petrosa near its base and through the antrum and excavative mastoid. E, Extreme auditory meatus. S, Groove for sigmoid. M, The mastoid. The osteoporosis about the antrum is evident.

pletely destroyed it. The portion of the jugular external to the skull seemed to be completely obliterated by new connective tissue, which was stained very dark yellow with blood-pigment. Near the occipital condyle the jugular could again be recognized, but the jugular bulb was completely filled above with a partially organized thrombus. The external surface of the occipital near the condyle was eroded and infected. The carotid was patent and easily recognized.

If we attempt, in the light of the autopsy, to analyze the symptoms in this case, and refer each to its pathologic source, we must first assume an early forgotten or overlooked middle-ear disease, perhaps as early as childhood or infancy. There can be little doubt that the antrum was the primary focus of the infection which made itself known by the chill of May 20th. The pharyngitis which was subsequently observed could not have infected the sigmoid sinus without producing a middle-ear disease, which certainly would have been recognized.

The facial neuralgia which was so marked a symptom during the first ten days cannot be explained by any clinical history in the literature with which I am acquainted, nor by the pathologic findings in the neighborhood of the fifth nerve. Since all the branches of this nerve were equally and simultaneously affected, the lesion must have been somewhere posterior to the ganglion; and since the neuralgia was only of short duration, without any remnant of subsequent pain or loss of function, it must have been nondestructive in its character.

The fifth nerve, as shown in the accompanying fig-

ure (Fig. 76), passes under the petrosal sinus and over the end of the petrosa. It does not pass very near the jugular end of the sigmoid sinus. If the petrosal sinus had been obliterated early in the course of the disease by the infected thrombus, the irritation of the nerve might have produced the pain. Had that been

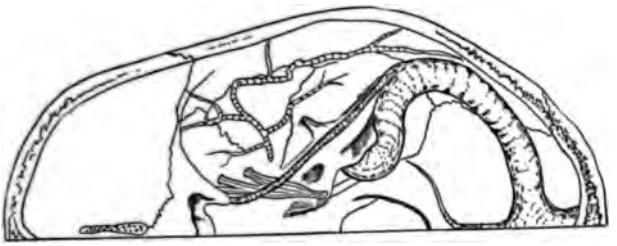


Fig. 76. Showing the relation of the fifth nerve to the petrosal and sigmoid sinuses.

the case, the petrosal sinus would have been the center of infection, which would have left traces on the bone. This was not the case.

The history immediately following the chill on May 20th is not sufficiently explicit to permit us to say whether the sigmoid sinus was or was not at once affected. Certainly by the last of June or the first of July we have the picture of sigmoid sinus thrombosis and infection. On or about July 10th, the sinus opened and drained into the retropharyngeal and retromaxillary spaces, and this gravity-abscess was discovered and first opened on July 14th. The character of the pus showed clearly that it arose from thrombosis.

There are two ways in which the pus might have escaped from the sinus into the retropharyngeal

spaces: the more direct and likely method, by way of the obliterated jugular; the less likely and less direct by way of the cavernous sinus, the maxillary veins and the pterygoid plexus. It seems highly probable from the symptoms that the jugular was obliterated in the neck during the first ten days of the sickness. It is unlikely that the cavernous sinus, and therefore the inferior petrosal sinus, was obliterated before August 25th, because until that time the hearing was good in both ears. This it seems could hardly have been the case if the labyrinthine veins had been obliterated.

During the latter part of July, the unobscured condition of the mind, the slight chills, the vomiting, and the septic temperature all spoke plainly for sinus thrombosis.

About August 5th the drainage into the pharynx and retromaxillary spaces became obstructed, probably by granulation tissue which was found post-mortem to close almost completely the posterior lacerated foramen, and the infected thrombus began to advance into the superior frontal sinus, and at last, on August 25th, into the lateral and sigmoid sinuses of the opposite side of the head. At this time the left jugular became thrombosed, and practically an abscess, as indicated by the pain, tenderness, and swelling in the neck. The slow-coming paralysis of the right leg speaks for the thrombosis advancing from the dura into the pia and appropriate cortical center.

August 30th some sudden and very general extension of the infection took place, probably entirely within the skull. This produced the convulsion and chill which began the end.

DIFFERENTIAL DIAGNOSIS BETWEEN ABSCESS OF THE BRAIN AND SINUS THROMBOSIS

In order to make a diagnosis between abscess of the brain and sinus thrombosis we have to consider the previous condition of the ear, the onset of the disease, and the symptoms which it manifests. In both cases there is coincident inflammatory disease in the petrosa. In abscess of the brain the disease is usually chronic, and often without any exacerbation; the abscess is usually located in the temporo-sphenoidal lobe. In sinus thrombosis the mastoid disease is usually of an acute form, or at least there is an exacerbation of the chronic disease. If the sinus thrombosis is attended by abscess, the abscess is in the cerebellum.

Both abscess of the brain and sinus thrombosis are prone to be accompanied or preceded by symptoms of local meningitis. Abscess of the brain is accompanied by headache, a low temperature, and usually by a single initial chill. The symptoms of cerebral compression are usually present. The mind is in a state of hebetude. In sinus thrombosis the chills are frequent, the temperature is high, and sometimes very high, and the pulse is rapid; there are no symptoms of compression, and the condition of the mind is irritable. Hebetude is rarely present. In both cases there is a marked leucocytosis.

In abscess of the brain there is rarely any sweating, the skin is of a normal color, pale and cold. In sinus thrombosis the skin is frequently bathed in perspiration, the hands are clammy and moist,

and the skin and conjunctiva are dusky and pigmented.

In abscess of the brain the bowels are usually constipated, vomiting is not uncommon, there is loss of appetite, though sometimes as the abscess grows there is vomiting and diarrhea. In sinus thrombosis there is a tendency toward diarrhea, the patient frequently takes large quantities of food, and vomits often.

Both brain abscess and sinus thrombosis have been frequently mistaken for typhoid fever, and when accompanied by the subsequent abscess in the lung the latter has been treated as a pneumonia. Both cerebral abscess and sinus thrombosis have been mistaken for malaria, for syphilis of the brain, and for uremia accompanying Bright's disease. In old people these diseases have both been looked upon, until the postmortem, as cases of apoplexy with softening.

EXTRADURAL ABSCESS

Extradural abscess, from disease of the antrum, appears in two separate localities. In the middle fossa of the skull it arises from perforation of the tegmen tympani in acute middle-ear disease, and in the posterior fossa it arises from the extension of infection from the mastoid cells into the extradural space, either by perforation or by communication through the natural channels in the thin wall of the bone. It is a stage in the progress of acute disease of the antrum rather than a separate disease in itself. It rarely appears in chronic disease of the ear, except in one of the acute exacerbations. It is rather more common in the posterior than in the middle

fossa. The symptoms to which it gives rise are not distinct enough to render a diagnosis possible, except occasionally when it appears in the middle fossa. Here it sometimes attains sufficient size to give localizing symptoms.

It is usually discovered in the course of operations for acute disease of the antrum, or for very severe attacks of recurring chronic disease.

Macewen (l. c. p. 69) recounts a typical case:

Extradural abscess over right tegmen tympani; leptomeningitis; sigmoid sinus phlebitis; operation; recovery.

J. M., age 36, with a good family history, was admitted to the Royal Infirmary January, 1892. He had been in good health with one exception. Twenty years previously he became chilled and had a severe pain in his right ear, which lasted a few days, and which was relieved after a free purulent discharge had issued from the ear. This discharge had continued ever since, but had not interrupted his work. Twelve days before admission he was seized with pain in the right ear, which was so severe as to cause him to go to bed. The discharge ceased. He had a giddy, confused feeling. On the fourth day he was very sick, and vomited frequently, and had a continuous sensation of cold. He thought there was a little swelling behind the ear at this time. He had perceived a bad taste in his mouth for the past few days. The day before admission he had a severe rigor. On admission he was very prostrate. His face had a grayish color. He lay on his right side with his hand covering the right ear, and apparently suffering much

pain. His intellect was perfectly clear, but he was hypersensitive to external impressions; slight touch, vibration, or noise caused him considerable annoyance. His head was slightly retracted. He had pain down the course of the internal jugular, which was surrounded by an edematous area, and bordered with enlarged lymph glands. There was no paralysis or inco-ordination of motion. His pupils were equal in size and reacted to light. The fundi had slight swelling of their inner margins on both discs, especially in the upper part. The margins were blurred, but the vessels were of natural size. The left ear was normal; the right ear discharged fetid pus. The membrane was gone, and the middle ear was filled with granulation tissue. The hearing in the right ear was absent, both by aerial and bone conduction. His pulse was between 70 and 84, and his temperature 102.2. His respirations were rapid, and he had a slight cough, with expectoration streaked with blood.

The mastoid antrum was exposed and found filled with granulation tissue and fetid pus. The tegmen was eroded and granulation tissue protruded through it from the dura. On removing the tegmen about three drachms of pus escaped from between the dura and the skull. The exposed surface of the dura was covered with granulation tissue. The sigmoid groove was opened, and the wall of the sigmoid sinus was found covered with a layer of plastic lymph. The sigmoid sinus was patent, though its walls were thickened. The pus was removed, the cavity washed out and rendered as nearly aseptic as possible, and dressed. The temperature became normal at the end

of forty-eight hours, and the patient made an uninterrupted recovery.

The following case occurred in my own practice:

Acute middle-ear disease of one month's standing; sudden appearance of intracranial symptoms; typical operation opening extradural abscess above the tegmen tympani; rapid recovery.

J. W., 28 years old, a healthy machinist, was afflicted suddenly with earache, which was relieved on the second day by discharge through the meatus. For a month the discharge continued. The patient occasionally went to a dispensary and had the ear washed out. Twenty-four hours before my first observation he had a severe chill with excruciating headache and vomiting. In a few hours he was able to come down town and consult a physician. His temperature was 104 and his pulse 110. The discharge from the meatus was as abundant as ever, but it seemed more watery. He was urged to submit to an operation, but declined. On the following day he consented to be operated on, and a typical operation was undertaken under chloroform. The only new symptom which had shown itself was slight dilatation of the left pupil. The antrum was found filled with fetid granulation tissue, which was removed very carefully with a sharp spoon. Immediately there appeared a stream of pus coming from a perforation in the tegmen. This was so large in amount that it was estimated at between one and one and a half ounces, but it was probably much less. The sigmoid groove was also opened, but found free from infection. The ear was replaced and

dressed in the usual way, and the patient made a slow but perfect recovery. The hearing was only very slightly less than normal three months after the operation.

ADAGES

1. Brain surgery is a fruitless and melancholy subject.
2. Rational antisepsis will prevent traumatic abscess of the brain.
3. Rational otology will prevent otic abscess and sinus thrombosis.
4. Abscess of the brain follows chronic sinus thrombosis and acute diseases.
5. Every suppurating ear is like a dynamite bomb in the head.
6. Surgery of the brain is forestalled by rational surgery of the scalp, the skull, and the middle ear.
7. Surgery of the middle ear should be placed in the hands of the expert aurist, but any physician must be ready to diagnose mastoid disease, and treat it if he has no aurist within reach.

LITERATURE

The literature on abscess of the brain, and the several related subjects, must be considered both as represented in the text-books and monographs, and in the current literature. The latter should be looked for in Gould's Yearbook, Sajou's Annual, Virchow and Hirsch's Jahresbericht, Schmidt's Jahrbücher, and the indices of current literature given in the Journal of the American Medical Association, and American Medicine. The literature on the anatomy of the ear will be found at the end of this chapter in Quain's Anatomy, and the several parts of Handbuchs der Anatomie des Menschen of

von Bardeleben. The literature on the surgery of the ear should be looked for in Schwartze's Handbuch der Ohrenkrankheiten, Jacobson's Lehrbuch der Ohrenkrankheiten, and the various journals on diseases of the ear, especially the Archives of Otology, and the Zeitschrift für Ohrenheilkunde. The general literature on the surgery of the brain can be found in von Bergmann's Kopfkrankheiten in the Deutsche Chirurgie, and in his later work, and also in Oppenheim's Die Encephalitis und der Hirnabscess, pp. 266 to 275.

The pathological aspects of the subjects considered, and their literature, can be found in such works as Hamilton's Pathology, and Ziegler's Pathology.

CHAPTER XI

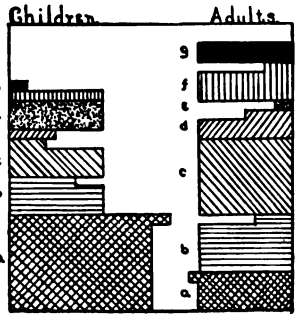
TUMOR OF THE BRAIN

The problem; the anatomy and histology involved; the pathology of brain tumors; the etiology of tumors of the brain; the symptomatology; general; localizing; diagnosis, course, and prognosis; treatment; literature.

Until recently interest in a tumor of the brain ended with its diagnosis. The prognosis of the case was absolutely hopeless, and any sort of treatment ineffectual except temporarily or in case of syphilitic tumors. During the past ten or fifteen years a great many brilliant cures have been accomplished through more careful and accurate methods of diagnosis. Nevertheless, it must be admitted that only a small proportion of brain tumors are amenable to surgical treatment. In many parts of the brain the location of a tumor cannot be reached, and in other parts the presence of the tumor cannot be determined. This leaves only a small number of cases in which surgical removal can be undertaken.

Tumors of the brain occur with almost equal frequency in childhood and in adult life. Gowers states that one-third of the cases appear in persons under twenty years of age. Among organic diseases of the nervous system in children, cerebral tumor holds a high place, being exceeded in frequency by meningitis, infantile paralysis, and cerebral hemorrhage. Starr

says that in 120 consecutive autopsies there is 1 brain tumor, and 7 out of every 100 brain tumors are accessible to the surgeon; 300 cases in children, collected by Allen Starr, give the following totals: 152 of these 300 tumors were tuberculous, 37 gliomatous, 34 were sarcomatous, 5 were mixed glio-sarcomatous, 30 were cystic, 10 were carcinomatous, 2 were syphilitic, and in 30 diagnosis was not made.



77. Diagram illustrating relative frequency of various forms of brain tumor in children and adults. The comparison is based on 300 cases in each class. Compiled by Allen Starr. a, tuberculosis; b, gliomatous; c, sarcomatous; d, glio-sarcomatous; e, cystic; f. carcinomatous; g, syphilitic.

In adults Starr also collected 300 cases, and found only 41 tuberculous, 54 gliomatous, 86 sarcomatous, 25 mixed glio-sarcomatous, 2 cystic, 33 carcinomatous, 20 syphilitic, and 41 were not diagnosed. Of these 600 cases, 43 were multiple in children, and 17 were multiple in adults, leaving 540 tumors single and alone; 148 of these 600 tumors were in the cerebral cortex, 141 were in the cerebellum, making 289 out of 600 tumors that were accessible to the surgeon.

Between January 1, 1893, and January 1, 1896, 65 tumors of the brain have been operated upon, making a total of 162 since 1885. Of these 137 were cerebral, and 25 were cerebellar. In 48 cases the tumor was not found at the operation; 39 cerebral, and 9 cerebellar. In seven cases the tumor was found, but not

78. TABLE OF BRAIN TUMOR IN CHILDREN AND ADULTS*

SITUATION	TUBERCULOUS		GLIOMATOUS		SARCOMATOUS		GLIO-SARCOMATOUS		CYSTIC		CARCINOMATOUS		GUMMATOUS		NOT STATED		TOTAL	
I. Cerebral axis:																		
1. Basal ganglia and lateral ventricles	14	3	3	9	5	8			1	1	1	2		1	3	5	27	34
2. Corpora quadrigemina and crura cerebri	16	1	1	2	3	2		5				1			1	7	21	14
3. Pons	19	11	10		5	1	2	1	1			2		3	1		38	17
4 Medulla	2			1					1		2				1		6	2
5. Base		3		2	1	3	1	1	1		1				4	1	8	9
6. Fourth ventricle	1		1		1	1					1	2			1	1	5	4
II. Cerebellum	47	8	15	8	10	13	1	6	9		3				11	10	96	45
III. Multiple tumors	34	4		2	3	5			2			2	1	3	3	1	43	17
IV. Cortex cerebri	13	9	6	19	1	46		8		1	1	19		13		12	21	127
V. Centrum ovale	6	2	1	7	5	7	1	4	15		1	3	1		5	4	35	51
	152	41	37	54	34	86	5	25	30	2	10	38	2	20	30	41	300	300

The first columns are children's tumors; the second, adults'.

*_M. Allen Starr_, Brain Surgery, New York, 1893; Wm. Wood & Co., p. 202.

removed; 5 cerebral, and 2 cerebellar. In 72 cases the tumor was removed and the patient recovered; 65 cerebral, and 7 cerebellar. In 35 cases the tumor was removed and the patient died; 28 cerebral and 7 cerebellar.*

During the three years, 1896 to 1899, 13 cases have been recorded in which tumor was not found.

The location of brain tumors is a matter of the greatest importance in deciding upon an operation. The probable situation of brain tumors is a matter of diagnostic importance. It will be seen from the accompanying table, prepared by Starr, from 300 cases of tumor of the brain in children, and from 300 cases of tumor of the brain in adults, that the axis of the brain is more frequently the seat of tumor in children, while the cortex is more often invaded by the tumor in adults, and when we add to this the other facts, that tuberculosis is much more common in children, and that multiple tumors are not to be operated upon, it leaves only a very limited number of operable cases in children, $\frac{57}{300}$, as compared with the operable cases in adults obtained in the same manner, $\frac{158}{300}$. The diagnosis of tumors of the axis is rendered more easy on account of the greater intensity of the symptoms to which they give rise, and on account of the many localizing symptoms which the situation in the base permits. The diagnosis of inoperable tumors is, therefore, generally more positive than the diagnosis of a tumor located in the cortex.

Tumors of the cerebellum are twice as common in

*Starr, Allen, A Contribution to Brain Surgery, with Special Reference to Brain Tumors, Med. Rec., Feb. 1, 1896.

78. TABLE OF BRAIN TUMOR IN CHILDREN AND ADULTS*

SITUATION	TUBERCULOUS		GLIOMATOUS		SARCOMATOUS		GLIO-SARCOMATOUS		CYSTIC		CARCINOMATOUS		GUMMATOUS		NOT STATED		TOTAL	
I. Cerebral axis:																		
1. Basal ganglia and lateral ventricles	14	3	3	9	5	8			1	1	1	2		1	3	5	27	34
2. Corpora quadrigemina and crura cerebri	16	1	1	2	3	2		5				1			1	7	21	14
3. Pons	19	11	10		5	1	2	1	1			2		3	1		38	17
4 Medulla	2			1					1		2				1		6	2
5. Base		3		2	1	3	1	1	1		1				4	1	8	9
6. Fourth ventricle	1		1		1	1					1	2			1	1	5	4
II. Cerebellum	47	8	15	8	10	13	1	6	9		3				11	10	96	45
III. Multiple tumors	34	4		2	3	5			2			2	1	3	3	1	43	17
IV. Cortex cerebri	13	9	6	19	1	46		8		1	1	19		13		12	21	127
V. Centrum ovale	6	2	1	7	5	7	1	4	15		1	3	1		5	4	35	51
	152	41	37	54	34	86	5	25	30	2	10	38	2	20	30	41	300	300

The first columns are children's tumors; the second, adults'.

*M. Allen Starr, Brain Surgery, New York, 1893; Wm. Wood & Co., p. 202.

children as in adults, 96:45, and if we throw out the tuberculous tumors, for which operation should rarely be performed, the ratio still remains, $\frac{49}{800}:\frac{87}{800}$. Tumors of the cerebellum are much more difficult to approach than tumors of the cerebrum, and success in operating in the cerebellum is far less promising, especially in the case of children.

Tumors that are located deep in the cortex are recognized at the operation with the greatest difficulty. Therefore, it is important to notice the probable situation of cortical tumors. In Starr's cases a total of 164 tumors were near enough the surface of the brain to have been reached by the surgeon. Those remaining, 436, were inaccessible. Of these, 46 cases presented symptoms clearly indicating the location of the tumor, and in 37 of these the tumor was so situated that, had the attempt been made, the operation would probably have been successful. That is to say, out of 600 tumors of the brain of all kinds, collected by Starr, 37, or six per cent, might have been operated upon with a reasonable show of success. Many of these tumors could have been diagnosed and located, but the tumor was so situated that surgical removal would have been impossible. Others could have been easily removed, but the symptoms did not render the diagnosis accurate enough to guide the surgeon to the proper field of operation. When all things are considered, when tuberculous and syphilitic tumors, secondary and multiple tumors, inaccessible and undiagnosable tumors, are excluded, there remain not more than two or three per cent of tumors of the brain which can be recommended to the surgeon for operation; and it

must be admitted that, even in the hands of the most skillful and the most experienced operators, some tumors will be met with which cannot be successfully removed, on account of a failure to recognize them because of the vascular and infiltrating character of the growth, or on account of other insurmountable difficulties. Patrick, considering all these difficulties, does not think that more than two or three per cent of brain tumors are subjects for successful surgical treatment.

The problem before the surgeon is a grave and relatively unpromising one, but the difficulties only intensify his interest and effort. It may be stated in four propositions:

1. The patient must suffer from a single, non-syphilitic tumor of the brain.

2. The tumor must be localized positively or relatively, and the situation must be accessible.

3. The situation must be approached and the tumor *found* and *removed.*

4. The cranium must be restored to its former integrity.

In order to carry out these propositions, it is necessary to become familiar with the pathology of each separate form of brain tumor, with the clinical appearance of these tumors in the various parts of the brain, with the symptoms which they present in the several locations and in the various forms, and with the distinguishing features and symptoms of related affections.

PATHOLOGY

1. Glioma and sarcoma appear with about equal frequency among children, but in adults sarcoma is much more frequent than any other tumor. Glioma in children, however, is found in the cerebellum more often than in the cortex of the cerebrum. Just the opposite of this is true in adults. On account of the vascular nature of glioma, and the fact that it infiltrates the brain; and on account of the difficulties of recognizing glioma during operation, it is one of the most unsatisfactory tumors to approach. In glioma, hemorrhage within or near the tumor sometimes occurs spontaneously, giving rise to symptoms of apoplexy. In a case of tumor of the brain, great and sudden changes in the intensity of the symptoms, accompanied by changes in the circulation of the retina, and affected by such measures as hot baths, cold douches to the spine, or free watery purgation, will indicate a vascular tumor, and probably a glioma.

Glioma is a form of tumor that appears only in the nervous system and the retina. It so closely resembles the tissue in which it appears that it seems to be a local hypertrophy. It is rarely separated from the surrounding tissues by a capsule, but rather infiltrates the adjoining functionating brain. The tumor is sometimes a clear gray, sometimes a grayish white, and sometimes a reddish gray, but occasionally it is a mixture of two or more of these forms, and on section appears mottled. Glioma is vascular, and in some tumors the blood-vessels are so much enlarged that the tumor has received the name glioma telangiec-

PLATE VII

SIGMOID AND SUPERIOR LONGITUDINAL SINUS THROMBOSIS.—The superior longitudinal sinus is opened and the clot removed. Thrombosis of the dural veins is clearly seen, and the greenish discoloration in the neighborhood of the sinus is very characteristic. An area of hemorrhagic pachymeningitis is seen over the right frontal lobe, and several smaller patches on the opposite side. Reduced from Lebert.

toides. In such tumors hemorrhagic infiltration follows rupture of a distended blood-vessel. Such hemorrhage is relatively frequent, and at autopsy the presence of the apoplexy may prevent the recognition of the tumor even when careful search is made for it, until a microscopic examination is resorted to.

Fatty degeneration, softening, and liquefying of the tumor, result in the formation of a cyst surrounded by a wall of active, proliferating tumor tissue. These cysts sometimes contain a clear fluid, sometimes a bloody or dark brown fluid, and sometimes a turbid mixture. The fluid resulting from degeneration of the glioma sometimes appears on one side of the tumor only, and the presence of the cyst may lead to the neglect of the brain-like tumor by the operating surgeon.

Gliomas vary from a millimeter or two to ten centimeters or more in diameter. When recognized clinically they are usually at least a centimeter in diameter.

Gliomas grow from the gray matter of the brain and cord, although some authors think they develop from the white substance (Bramwell).

The histology of the glioma should be studied carefully in order that its clinical manifestations may be understood.

2. Sarcoma and mixed tumors, such as glio-sarcoma and osteo-sarcoma, are more common in adults than in children, and they further show a tendency to appear in the cortex. Sarcoma may grow out of the skull itself, or out of the brain substance, but it usually springs from the brain coverings. In the brain it arises from the sheaths of blood-vessels. When it

originates in the membranes, it appears on the one side of the series as an encapsulated, nodular tumor, or on the other as an infiltrating, or flat, shapeless mass. When it appears as a sponge-like mass on the convexity it has been termed fungus durematris. Sarcoma of the brain itself can usually be distinguished at operation or autopsy by the sharp border separating the tumor from the brain substance, and by the ease with which it may be enucleated. Encapsulated sarcomas of the membranes, or of the brain, displace by pressure the surrounding convolutions and make a sort of mantle for themselves out of the pia, or compressed and sclerotic tissues.

Sarcomas present the same variations in size met with in gliomas. They even reach enormous size, probably producing less violent symptoms in proportion to their bulk. In a case diagnosed chorea at the Cook County Hospital, a little negro girl with no loss of vision, but paralysis of the opposite side and occasional twitching of the face on the same side as the tumor, proved at the autopsy, which was made after a few days of sickness, to have suffered from a tumor of the left hemisphere of the cerebrum, practically obliterating it, and reaching over to the opposite side of the falx. Sarcoma appears as a soft tumor or as a very hard growth. The latter is usually close to the dura and of slower increase. In the soft tumors hemorrhagic infiltration is observed and myxomatous and cystic degeneration are met with quite often.

The histologic structure of sarcoma of the brain presents the same series of appearances as is found in sarcomas elsewhere located.

3. Cystic tumors of the brain arise either in connection with glioma, or sarcoma, or they are of parasitic origin. In Germany, especially in the province of Mecklenburg, and in Australia, hydatid tumors of the brain are met with in greater frequency than in any other parts of the world. Cysts which are merely the result of degeneration of the products of a previous hemorrhage, or infarction, are not to be reckoned as tumors, because they do not grow and do not produce the symptoms of tumor. Cysts of the brain of parasitic origin form very slowly. They do not destroy, but displace the brain tissue, and they rarely give rise to localizing symptoms.

4. Tuberculosis is a much more common cause of tumor in children ($\frac{152}{800}$) than in adults ($\frac{41}{800}$). These tumors are rarely subjected to operation, and then usually on account of an error in diagnosis. They are usually multiple, and situated in the cerebellum or at the base, and involve the coverings of the brain rather than the brain tissue itself.

5. Gumma of the brain is certainly the most common manifestation of brain tumor met with at the bedside, but in Starr's tables there were only twenty-two in six hundred cases. It is of course more common in adults than in children. Nearly all authors agree that it should not be subjected to operative treatment, but Horsley recommends operating for gumma as well as for other tumors.

6. Primary carcinoma of the brain is one of the rarest forms of tumor and appears among adults rather than among children. Secondary carcinoma is not subject to operation, the only exception being the

carcinoma which begins in the retina and spreads to the base just beyond the orbit.

7. Fibroma is a rare form of brain tumor of little surgical interest. It is usually of small size, but Keen extirpated one from the fore brain of immense size. The greater number of fibromas are to be found in the cerebellum and in the dura of the base. Fibrocystomas are rare forms which might better be termed cystic lymphangiomas.

Osteoma and osteofibroma, chondroma, and other mixed tumors inside the cranium are pathologic and surgical rarities. A few osteomas have been found unconnected with the skull and loose in the brain. (Siemon, Thesis, Marburg, 1893.)

8. Lipoma, so common in many other parts of the body, is one of the rarest tumors of the brain. It has been observed in the corpus callosum, corpora quadragemina, in the ventricles, and on the dura. Single instances of lipoma in the hypophysis and in the corpora candicantia have been described (Weichselbaum, Fèrè), and in one case the lipoma underwent ossification (Benjamin). In many cases the interior of the lipoma liquefies and becomes a cyst of fat or oil, or in other cases the tumor undergoes calcification. Klebs (Die Allgemine Pathologie, 11, p. 682) describes these tumors under the title, "So-called Heterotopic Lipomas."

9. Psammomas of small size are often found in the pineal gland. Similar tumors as large as a cherry are occasionally observed in other parts of the brain at autopsies of patients who had never suffered from their presence. As pathologic rarities larger psammomas are occasionally reported in the literature.

They usually grow out of the dura, especially that of the base. They are hard, smooth, white, or grayish-red tumors. Sometimes they attain the size of a walnut (Hamilton) or apple (Arnold). They are not always harmless, but give rise to symptoms wholly similar to the symptoms of other tumors. Mitchell and Thompson (Am. Jour. Med. Sciences, 1873) report a psammoma that gave rise to symptoms in the fourth and fifth cranial nerves.

Klebs (Die Allegemine Pathologie, II, p. 630) and Hamilton (Text-Book of Pathology, II, p. 738) look upon the psammoma as a variety of endothelioma. The tumor is composed of agglomerations of flat cells surrounding blood-vessels, all undergone calcification. They grow out of the inner layer of the dura.

10. Cholesteatomas of the brain are almost always found accidentally at the autopsy table. These white, glistening, pearly tumors are found at the base of the brain, directly on the bone or in the meninges, especially in the neighborhood of the petrosa. They are rarely found within the brain, and when so found, are usually the result of degeneration of dying tumors. They are composed largely of cholesterin, hence their name. They are rarely larger than a cherry, but cholesteotomas as large as a hen's egg or the fist (Petrina, Prager Viertelyahrschrift, 1877, and Osler, Journal of Nervous and Mental Diseases, 1887) have been found. Some of these cholesteotomas are believed to be the remnants of hydatid cysts (Hamilton).

11. The hypophysis cerebri sometimes takes on unnatural activity, and develops into an adenoma. The tumor is usually a simple hypertrophy of that

organ. It does not often attain to any considerable size. It is usually not much larger than a walnut, and frequently is found in a condition of colloid degeneration or cyst formation. It has been studied by Weigert as struma glandulæ pituitariæ. A tumor he described was as large as an apple. Disease and tumor of the hypophysis is associated often with the condition known as acromegaly. In other cases, cirrhotic changes in the kidneys, uterus, and ovaries were present without acromegaly.

12. Syphiloma and solitary tubercles and tuberculous lymphadenomas of the size of hazel-nuts up to the size of hens' eggs are not unknown. They are usually of slow growth, of peripheral location, and may be unaccompanied by any striking evidence of syphilitic or tuberculous disease elsewhere.

Actinomycosis of the brain is to be remembered when there are evidences of actinomycosis elsewhere in the body.

There are a number of tumors of the brain so rarely found, and accompanied by so little inconvenience to the patient, that they are of interest to the surgeon only from their pathologic and theoretic importance. There are a few other rare tumors which prove inconvenient to the patient, but they are, so far, inaccessible to the surgeon in spite of an early and positive diagnosis.

ETIOLOGY

Our knowledge of the etiology of tumor of the brain is very incomplete and unsatisfactory. A few tumors are due to congenital errors of development.

These tumors are very rare; the dermoids, the teratomas, and the true angiomas. The infectious tumors, due to syphilis and tuberculosis, are as well understood as these diseases are elsewhere. Actimomycosis and echinococcus are almost too rare to mention, but their presence is readily understood.

Trauma seems to be a predisposing cause of tumor of the brain, but its exact relation to the growth of the tumor is very difficult to understand. In 60 cases of glioma, collected by Gerhardt, 10 seemed to be related in some manner to trauma, while in 11 cases under the direct observation of Oppenheim, 4 had a similar etiological suggestion. The appearance of metastatic tumors in the brain coming from carcinomas and sarcomas elsewhere in the body, and especially from the lungs, is easily understood, but is of little clinical significance, as they are inoperable.

SYMPTOMS OF TUMOR OF THE BRAIN

The symptoms produced by the growth of intracranial tumors may be grouped into two classes. In the first class are the general or diffuse symptoms, and in the second class the local or focal symptoms. The general symptoms are those which are produced by the growth, whatever its situation, while the focal symptoms are those which depend upon, or afford some indication of, the situation of the tumor. The general symptoms, as a rule, are the first to make their appearance, but they may appear coincident with localizing symptoms.

A. General Symptoms.—There are seven important general symptoms of tumor of the brain; the three or

four first to be mentioned are often spoken of as cardinal symptoms: they are, (1) headache, (2) choked disc, (3) impaired cerebration, (4) general convulsions, (5) vomiting, (6) dizziness, and (7) slowing of the pulse.

1. Headache is the most constant symptom of brain tumor. It is usually the first to be recognized. In only a small proportion of the cases of this disease is headache absent. Knapp found it in 401 out of 614 cases. The pain is described as constant with frequent paroxysmal exacerbations. Less frequently there is complete intermission between the attacks. The pain is described as dull or acute, sometimes as rending, tearing, stabbing, or boring. Sleep is disturbed or absolutely impossible. The agony is sometimes so terrible as to drive the patient to suicide. Anything which increases the passive congestion of the brain—for example, exercise, bending forward, or a sudden jar, sneezing or coughing—increases the pain. The pain increases in severity and in the frequency of exacerbations as the disease progresses until the very end of life, when relief comes in unconsciousness through the growth of the third symptom. The pain is frequently worse in the morning, and this appears to be due to the recumbent position during the night, and the sinking of the tumor backward. It is especially noticeable in tumors in the posterior fossa.

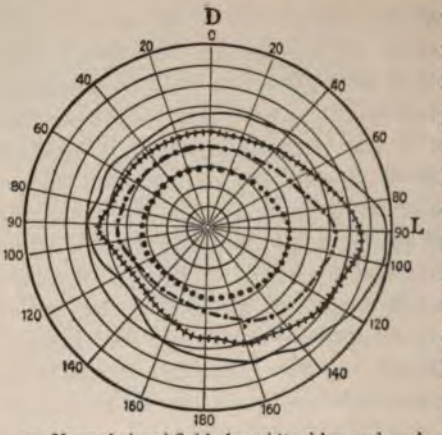
The pain is usually diffuse and referred to the whole head, but sometimes it is described as deep-seated. Again, it is localized in the frontal region, or in some other portion of the skull. Occasionally only one side of the head aches, and in these cases the

location of the pain is constant, or it shifts from side to side. In tumor of the cerebellum the pain seems to be more commonly located in the base of the skull and the occiput, but it is also frequently observed as well-located pain in the frontal region. When the pain appears in any locality with great constancy it is usually indicative of tumor in that locality, but in many instances the tumor is found elsewhere, and even upon the opposite side of the head. The early appearance of pain in the order of symptoms has been thought to indicate a tumor situated near the meninges, while a late appearing and diffuse pain has been looked upon as diagnostic of a tumor of the base. When the pain is of a pulsating character it may give rise to the suspicion that the tumor is of a vascular nature.

The headache is sometimes accompanied by a pain referred to one or more of the branches of the fifth nerve, in which case it seems to be accompanied by a facial neuralgia. The pain seems to be more severe in children than in adults, but certainly it is more paroxysmal in character and of greater intensity in tumors of the cerebellum.

2. Choked disc, or optic neuritis, appears in more than half of the cases of tumor of the brain.* It has sometimes been looked upon as pathognomonic, but it appears under other conditions of intracranial disease. It manifests itself as a limitation of the field of

*Reich, in 1874, soon after the discovery of ophthalmoscopy, reckoned that choked disc appeared in 95% of all cases of tumor of the brain in which this method of diagnosis was used. Edmonds and Lawford found optic neuritis in 64% of fatal cases of brain tumor. Wm. H. Wilder collected 140 cases of tumor of the brain in which 75% presented symptoms of optic neuritis. It is probable, however, that in some of these cases this symptom appeared later than the examination reported, and some time before death.



79. Normal visual fields for white, blue, red, and green in the right eye.

80. Fields for white, red, and green of the right eye in a case of tumor of the brain.

WHITE
RED
BLUE
GREEN

vision, which is more pronounced for the red and green rays than for the others. It usually comes on gradually with loss of vision, but sometimes, as in the case of tumor of the frontal lobe which Patrick observed, choked disc and absolute blindness appeared suddenly in one eye, and two days later there was complete blindness of the opposite eye. When the neuritis is gradual, the patient unconsciously loses vision, until it is reduced to $\frac{3}{60}$ths, or one-third of the normal, and all attempts to improve it by op-

ticians' spectacles are unavailing. The patient frequently complains more of the coincident headache than of the blindness, and is led to seek the ophthalmologist's advice on account of the reputation of glasses for the cure of headache. A dilatation of the pupil with atropin, and an examination of the fundus, which is a routine practice in every ophthalmologist's office, discovers the retinitis, and immediately arouses a suspicion of serious disease. Choked disc, while clinically separated from optic neuritis, is pathologically associated with it in a single pathologic entity. Up to the present time there seems to be no explanation which answers all the requirements of the appearance of choked disc and optic neuritis in the course of tumor of the brain. von Graefe thought it due to increased intracranial pressure, which compressed the cavernous sinus, and led to disturbance of the circulation of the eye, and congestion of the vessels at the head of the optic nerve. This theory was for a long time universally accepted, but there are many cases in which it proves inadequate. For instance, the most pronounced choked disc has been observed with a tumor less than a centimeter in diameter, while in other cases, tumors ten centimeters in diameter have been unaccompanied even by a trace of optic neuritis. Schmidt and Manz attribute it to an increase in the lymph surrounding the optic nerve and resulting atrophy of the nerve elements. In many cases of tumor of the brain the sheath of the nerve is distended with lymph and the vessels of the retina are congested and there is great swelling of the optic disc. This edema they attribute

to increase of cerebro-spinal fluid, but in cases of hydrocephalus, with much greater increase of cerebro-spinal fluid, there is no choked disc. Leber, however, thinks the optic nerve is irritated by poisonous products produced by the growth of the brain tumor, which enter the nerve sheath at the lamina cribrosa, and excite a true inflammation in the nerve. Under this hypothesis it seems difficult to account for the sudden appearance of exaggerated choked disc.

When this symptom is prominent it is important to consider the other sources of retrobulbar neuritis. It has been known to occur from severe physical exercise. Fuchs records the case of a young man who rode a very long distance on a bicycle and was attacked the next day by a bilateral optic neuritis, and Casey Wood has a similar case under observation. It follows injuries to the eye, either by traumatism or by the extravasation of blood in the orbit, or the pressure of a tumor, or the retraction of the globe in the course of operation within the orbit. It sometimes follows violent weeping, and there are cases in which it occurs without any adequate or assignable cause. These cases were formerly termed idiopathic. Optic neuritis frequently follows the acute infectious diseases, such as scarlet fever, typhoid, measles, smallpox, and influenza, but it is especially frequent in the course of a chronic nephritis. In fact, the first thought after the discovery of a retinitis is of Bright's disease or of tumor of the brain.

Gowers finds optic neuritis in four-fifths, and Knapp in two-thirds of the cases under observation.

It is probable, as Oppenheim says, that choked disc

is less frequently present than these statistics would indicate in the early stages of the disease, when operation for the surgical removal of tumor of the brain would be possible.

Church observes that choked disc sometimes appears only two or three days before death. In such cases it would be of no diagnostic value.

3. The emotional and psychic symptoms are sometimes so conspicuous as to overshadow all others. The following case, reported by A. F. Lemke,* is suggestive in this connection.

Sarcoma of frontal convolution; dementia.

"This is a brain from a patient who died at the Kankakee Insane Hospital. The patient was admitted to the asylum with a diagnosis of general paralysis, the diagnosis having been made by several physicians, on account of dementia. It was my custom to examine the eyes of all new patients with the ophthalmoscope, and while going through the ward for this purpose, I discovered accidentally that this woman had a marked double choked disc. I questioned her carefully, and learned that the symptoms were those of brain tumor. She had several attacks of vertigo and vomiting, and had had disturbance of vision for some time. She located her headache in the frontal region. When I first saw her at the hospital all the reflexes were exaggerated. She had no focal symptoms; she had a very peculiar bilateral twitching of the face. This occurred at intervals of a few seconds throughout the day. She finally had several convulsions,

*Journal Am. Med. Assn., July 29, 1899.

vomited a great deal, and after having been in the institution for about a year and a half she died. A postmortem examination was made, and this brain tumor removed. There was tumefaction of the left frontal lobe. The hemispheres were separated. On the right hemisphere in the frontal lobe an excavation was noticed which had been made by the tumor. The tumor did not appear to have involved or infiltrated the brain structure, because we were able to shell it out of the brain tissue without any difficulty whatever. It was about the size of a small orange, decidedly irregular, and rough, made up of a good deal of connective tissue, and the microscope showed it to be a sarcoma with much fibrous tissue.

"The interesting feature of the history in this case was, that a tumor as large as this seems never to have created focal symptoms, and for that reason the tumor was not located antemortem.

"I presume it is not out of place to speak of the possibility of this tumor having been removed surgically. It shells out of the left frontal lobe so easily and readily that some surgeons have expressed the opinion that it might have been removed surgically with very excellent results. Had this been done, it would have left quite a defect in the brain, but the woman's mental condition was about as bad as it could be, and at any rate, a surgical operation might have been attempted if the tumor could have been located."

The psychic symptoms of tumor of the brain are so various that they can hardly be described. They verge all the way from mildest paranoia to mania,

melancholia, and dementia, and they are sometimes connected with localizing symptoms.

4. General convulsions and loss of consciousness are common symptoms of brain tumor. They appear as a cortical epilepsy, and sometimes point to the location of the tumor. They appear at all stages of the course of the tumor. The convulsions sometimes overshadow all other symptoms, and the case is considered to be one of epilepsy. After ten to thirty years the other symptoms of brain tumor show themselves, and at the operation or postmortem the tumor is discovered. The convulsion is sometimes of a trifling nature, resembling petit mal or automatism.

5. Vomiting is one of the most constant symptoms of brain tumor. It is an early and characteristic symptom. It occurs without any nausea or premonitory symptom, and without regard to the condition of digestion. It is sudden, sometimes projectile, and usually of short duration, being limited to a single contraction of the abdominal wall and stomach. It frequently occurs at the height of an attack of headache. It is a more constant symptom of tumor of the cerebellum than of the cerebrum. Jacoby found this symptom in 172 out of 568 cases.

6. Dizziness is a symptom of great variability, but of considerable frequency. It appeared in thirty-one per cent of Mills and Lloyd's cases. It varies between an unsteadiness and uneasy feeling in the head and a complete loss of equilibrium. It seems to be a little more common in tumors of the cerebellum and in tumors of the frontal lobe than in those of other parts of the brain.

So-called cerebellar ataxia is a symptom of tumor of the frontal lobe.

The tumor may, in a child, cause the sutures of the skull to open a centimeter or more, as happened in the case of a four-year-old child observed by Sidney Kuh, in which there was an enormous tumor of the right hemisphere with Jacksonian epilepsy involving the arm on the same side of the body (Ledderhose, Langenbeck's Arch., Band 51).

In some cases the symptoms point so strongly to the deep location of the tumor that operation is not recommended, and the postmortem shows that the case was perfectly operable. Such a case was reported by W. W. Keen (Am. Jour. of Med. Sciences, January, 1894, p. 43). The patient was a boy seventeen years old. He manifested evidence of tumor of the cerebrum, evidently in the left mid-brain. The optic symptoms were pronounced, and Agnew thought it a brain tumor too deep for operation. At the autopsy it was found to be easily accessible, but of very large size.

7. The slowing of the pulse is a symptom which appears usually in connection with headache. It is an early symptom in many cases of tumor of the base. It seems to be connected with increase in intracranial pressure, and is accompanied by slowing of the respirations. Horsley has noticed that the pulse rose as soon as the cranium was opened. The pulse is often found as slow as forty to fifty in the minute. Oppenheim noticed that it is an early symptom of tumors in the motor area. It must not be forgotten that occasionally tachycardia is a prominent symptom in brain

tumor. It is difficult to decide whether it is due to some irritative action of the tumor or to heart exhaustion.

8. There are other general symptoms of tumor of the brain which are of little diagnostic, but of great scientific, interest. Among them are the osteoporotic condition of the skull which is possibly due to increased vascularity either as the result of a toxic symptom going out from the tumor, or the increased circulation due to intracranial pressure; a thickening of the dura and pia, possibly of a similar etiology, and an interference with the function of the cranial nerves, due either to the pressure upon the nerves at their exit, or some interference with their function similar to that of choked disc. A still rarer symptom resulting from brain tumor is a hydrocephalus. This has frequently been noticed as a primary condition before the tumor was suspected.

B. Localizing Symptoms.—In considering the possibility of determining the position of a brain tumor we must remember that only peripheral tumors are operable. Centrally located tumors are beyond the reach of surgery. The sources of our information in regard to the location of any tumor are at the best indefinite in a great majority of cases. It is our duty to decide, if possible, whether the tumor is centrally or peripherally located. If it is centrally located, we must wait for the postmortem. If the tumor is in one or more of the motor areas, and grows rapidly, it sometimes gives rise to unmistakable localizing symptoms. These areas are described in a previous section under cerebral localization. There are, however, tumors in these

areas that give rise to no symptoms until it is too late to consider removal.

In speaking of the location of a cortical tumor, it must be remembered that the symptoms of a tumor in the cortex, and a smaller tumor anywhere in the cone of connecting nerve filaments, would be practically the same. Thus many tumors have been incorrectly located on the surface of the brain, and found by operation, or postmortem, to be located in the cone, deeper down, and nearer the center or the base of the brain.

The symptoms naturally group themselves into those due to irritation, and those due to destruction. If a tumor is located, for example, in the cortical motor area for a finger, it might produce an irritative action resulting in clonic or tonic spasm of the finger. Such a case was observed by von Bergmann. The left index and ring fingers frequently had a prickling sensation, which was followed a month later by an involuntary motion lasting several minutes. These irritative lesions extended to the whole arm and shoulder, and a month later to the leg of the same side, when death occurred. The tumor was only the size of a walnut, and was found located just under the pia, but being of a carcinomatous nature, accompanied by carcinoma of the liver and lung, secondary to carcinoma of the rectum, it naturally was inoperable.

Jacksonian epilepsy is a manifestation of the irritation of tumor in a considerable number of cases. It is frequently preceded by an aura of abnormal sensation in the localizing part, and is a valuable symptom when present.

Tendon phenomena are frequently observed, and have sometimes been adequate to localize the tumor.

Monoplegias of various kinds are valuable localizing symptoms, but they usually appear in infiltrating and deep-seated tumors, and in tumors of large size.

Complete aphasia, or various modifications of the faculty of speech are symptoms that appear in cases of tumor of the speech center or its connections. This symptom is a very conspicuous one, and is easily recognized quite early in the course of the disease.

Occasionally the location of the tumor is indicated by a localized tenderness of the skull, a protrusion of the tumor through the atrophied skull itself, or by a bulging of the skull over the tumor. Such cases are not common.

Percussion of the skull sometimes suggests the location of the tumor, but it is a method which has been disappointing in its results.

In locating tumors of the brain the X-rays have frequently been used, and in a few cases positive results have been obtained. Church (Chicago Medical Recorder, April, 1900, pp. 257-278) mentions a case of his own, and refers to one in the hands of Carl Beck, in which the X-ray located the tumor, and operation confirmed the diagnosis.

DIAGNOSIS

The errors in diagnosis which have led to a futile operation, have been, in the majority of cases, inevitable. In many cases the symptoms have pointed to the motor area, or to the cerebellum, as the site of the tumor. The tumor has really lain either deep beneath

the cortex, or at some distance from the motor region, or in the frontal lobes, since tumors at some distance from the motor area may cause motor symptoms indirectly by irritation or by pressure. It seems impossible in some cases to avoid this first error. The occurrence of ataxia of a cerebellar type, from lesions of the frontal lobe, has led to the second error. Bruns (Deutsche med. Wochenschrift, 1892) was the first to point out the fact that frontal lesions often cause ataxia of a cerebellar type, and this fact has been confirmed by Cebas, Dinkler, and Hermanidas. In a recent monograph on brain tumor, Bruns has pointed out the differential points between frontal and cerebellar ataxia, as follows: frontal ataxia is often associated with hemiparesis; there is usually a localized tenderness to percussion or to pressure over the frontal region; optic neuritis occurs late in the course of the disease, and mental dullness is an early symptom. In cerebellar ataxia there is rarely hemiplegia; there is no tenderness over the frontal region; optic neuritis with hemorrhage in the retina occurs very early in the disease, and is attended by blindness and with other symptoms of brain tumor, such as vertigo, vomiting, and slowness of pulse developing early. Mental symptoms, such as dullness and apathy, occur late. These points should be noticed, inasmuch as a staggering gait has been supposed to be quite characteristic of cerebellar lesions. The prognosis in cerebellar tumors is very unfavorable. In fact, out of 25 operations for cerebellar tumor, while 7 cases have recovered from the operation and lived a few weeks, only 2 have been permanently benefited.

The second class of cases is that in which a tumor was found, but usually because of the nature of the tumor, its removal was impossible. This is a matter of uncertainty always. In nearly all of the cases it seems that an earlier attempt at operation might have succeeded. Five cases of this kind were reported before 1893, but only four cases since that time.

We come now to the third class of tumors successfully diagnosed and successfully removed. These number at present 107, with 72 recoveries from the operation. It is to be recollected that statistics show that of every 120 autopsies in hospitals, brain tumor is found in one case, and that seven per cent of these are subject to hopeful operation, or one case out of 1,714 hospital cases. It seems, therefore, that a good proportion of favorable cases are now operated upon, and the percentage of recoveries is gradually increasing. Many patients are now alive from whose brains tumors were taken four, five, and six years ago.

The most favorable cases are those in which the tumor was found in the motor region of the brain, producing first a localized spasm, and localized paralysis, or in the speech area of the brain, or in the visual areas of the brain. In all of these cases localizing symptoms make a diagnosis easy, and the removal of the tumor does not present many difficulties in the hands of the experienced surgeon.

DIFFERENTIAL DIAGNOSIS

Brain tumor is of so rare occurrence that the symptoms of the disease are apt to be overlooked, and the condition diagnosed as one arising from other and

more common causes. The headache and the vomiting call attention to a possible migraine, or to disorders of the stomach. If the patient is neurasthenic, as is usually the case in tumor of the brain, the headache is referred to neurasthenia. Since the general mental conditions may assume almost any form, they may simulate hysteria, and the condition may be referred to as hysterical. Church mentions that distinct hysteria was present in four out of his 23 cases of brain tumor. Abscess of the brain, hydrocephalus, anemia, apoplexy, uremia, and diabetes, are conditions which have been diagnosticated in cases of brain tumor; and the appearance of melancholia, mania, and paranoia, have frequently led to the arrest of any further investigation until the localizing symptoms or the postmortem have cleared up the diagnosis.

Tumor of the brain must be differentiated from general paresis. In a tumor of the frontal lobe, and in another case of gumma in the same region, there were delusions in the latter case and extreme optimism, especially in regard to an illusionary invention which the patient professed to have in hand, with a tendency to joke and laugh without natural cause. In the former case the young girl had the flippant, happy, elevated, pseudo-witty manner of the general paretic, (Patrick). Frequently the symptoms of paresis are followed by convulsions or other symptoms that clear up the diagnosis, or choked disc shows itself. Sometimes the symptoms are those of melancholia with suicidal mania, as in a case reported by J. B. Herrick.

Tumor of the brain has been mistaken for tuberculous meningitis, especially in children. A case of this

kind was reported by George H. Weaver (Jour. Experimental Medicine, 1898).

Brain tumor has been mistaken for neurasthenia on account of the similarity of the headache. The headache comes on in those cases about 3 A. M., and continues until after a good breakfast.

Tumor of the brain resembles epilepsy, especially when observed in children. Sidney Kuh observed such a case in a boy thirteen years old. The patient had violent headaches with mental disturbances following them, and then epileptiform fits, with hallucinations of objects, mostly in red. A diagnosis of epilepsy was made, but just before death pronounced symptoms of tumor of the brain appeared, and a gliosarcoma was found at the autopsy.

Tumor of the brain may be coincident with middle-ear disease and abscess of the brain, as in a case reported by Daniel Brower (Jour. Am. Med. Ass., August 5, 1899).

Tumor of the brain has also been mistaken for epilepsy, as in Schoenthal's case, in which a tumor of the brain was unexpectedly found, postmortem.

The fact that a patient improves under antisyphilitic treatment, even for three or four months, does not speak very strongly for syphilis. Very many patients improve under such treatment, and at postmortem the brain tumor is found to be sarcoma.

Washburn and Lane report an interesting case of brain tumor successfully diagnosed and successfully removed.

The patient, a woman of forty-six years, was seized with a fit on May 4, 1896. It commenced as a con-

vulsive twitching of the thumb of the right hand. This extended to the forearm and to the upper arm, the elbow being forcibly flexed. The leg on the same side was then similarly affected, the knee being bent. She did not lose consciousness. After the fit she noticed that her right arm and leg were weak, and that the right side of her lips and tongue were numb. During the interval that preceded her admission into Guy's Hospital, on August 27, 1896, she had a similar fit about every fortnight, the date of the fit corresponding to her menstrual periods, which were very frequent. She gave no history of headache nor of vomiting.

On admission, her right side was found to be distinctly weaker than the left. During the time she was under observation she had fits similar in character to those already described. As she did not improve under antisyphilitic remedies, it was decided to explore the brain on the left side.

On September 19th a large area of bone was removed, and the dura mater, which was healthy, exposed. On the following day she had two fits. On the 21st the dura mater and archnoid were divided, when a tumor was exposed. It grew from the pia mater and deeply indented the brain, immediately in front of the upper limit of the fissure of Rolando. The tumor was sharply defined and shelled out readily. Though not invading the brain substance, a minute portion of gray matter was found adhering to its under surface. The longest diameter of the growth was from before backwards, where it measured about two inches, while its transverse measurement

was about an inch and a half. Its depth appeared to equal its breadth. The convolutions depressed by it comprised the upper portion of the precentral gyrus, the adjacent area of the first frontal, with part of the second frontal, the marginal gyrus, and probably to some extent the gyrus fornicatus.

Aphasia, with paralysis of the right arm and of the right side of the face, followed the operation. The aphasia soon disappeared. When she left the hospital on January 24, 1897, she had complete motor paralysis of the right hand and forearm, with impaired sensation in the fingers. She had lost the pain in her arm, which existed previous to the operation and was temporarily increased by it. The facial paralysis had also disappeared. She had no recurrence of the fits after the removal of the tumor. At present, movement is returning in the fingers, but the rest of the arm is still paralyzed.

It is curious that the fits should have commenced in the hand, considering the position of the tumor, and that, after the operation, the paralysis should have been mainly localized in the arm and hand. The paralysis was probably due to an injury of the cortex, for a combination of sensory and motor phenomena, due to injury to the internal capsule cannot be explained, unless all the strands intervening between the two sets of fibers were also implicated. If due to injury of the internal capsule the symptoms would probably have been more widespread.

When the diagnosis is tolerably absolute, both as to the presence of tumor and as to its location, the neoplasm may not be discovered at the operation, on

account of overlying strata of brain, or on account of the similarity of the consistency of the tumor to that of the brain substance. The following two cases, reported by Hugh Patrick, illustrate these difficulties:

PATRICK, HUGH T. (Jour. Am. Med. Assn., July 29, 1899). *Glioma of the arm area of right hemisphere, properly diagnosed; operation, but not discovered; autopsy.*

The patient was a girl, sixteen years of age when I first saw her, in April, 1895. In July, 1894, she had two prolonged convulsions, another one in October, and up to the time when I first saw her, it was supposed to be a case of hysteria, because of the peculiar character of the fits. After these general convulsions, which she had in July and October, she began to complain of pain in the right side of the head and right eye. A little later (in December) she had a number of local fits. She worked in a store, and every few days she would have a clonic spasm of the left arm, which, after a short time, involved the face. The arm would jerk and twitch in a peculiar way so that she would try to hold it with the other hand, and the other girls would laugh at her. When I saw her she was confined to her bed with headache of the right side of the head and right eye, left hemiparesis and strabismus. There was diminution of sensation on the left side; muscular sense was much impaired, and there was the inco-ordination which ordinarily accompanies this symptom. She had double optic neuritis.

On account of her age, and lack of evidence of syphilis on examination, I advised operation at once,

as the girl seemed to be in a critical condition. She could walk, but clumsily, and as I had seen not long before this a case of tumor with a sudden apoplectic termination, I advised immediate operative interference, rather than to await the results of antisyphilitic treatment. I had a talk with Dr. Senn before the operation was done, and said that the growth would probably be a flat sarcoma, which sometimes spreads out on the surface, or it would be a deep-seated subcortical growth on account of the extent of the paralysis. It did not seem to me that a small tumor in the cortex could account for the symptoms. The patient was accordingly operated upon, a large opening being made over the arm center. Nothing was seen, although the intracranial tension was great, and the brain pulsated perfectly; by palpation through the dura nothing could be felt. Surgical considerations aside, I was in favor of making an incision into the brain, but Dr. Senn thought he would surely get an enormous cerebral hernia, and so this was not done. The operation, however, relieved the girl completely for at least three months; that is, the optic neuritis nearly disappeared, the strabismus disappeared, as did practically her hemiparesis. She regained her normal disposition, which before operation, aside from mental hebetude, had been irritable. She became cheerful and happy, and was quite herself. She had no treatment of any kind for about three months following the operation, when headache returned, and she was put upon iodids with some temporary relief. Again her headache returned, and she did not come back to me. The next thing I heard was that Dr. Fenger was going

to operate for the removal of this tumor. I went to see the operation, but it was decided to put the patient on specific treatment, namely, iodids and mercury, which relieved her for about three months. The patient then drifted from one physician to another, until one surgeon, doubting the diagnosis of brain tumor, aspirated supposedly the lateral ventricle, with instant relief. The headache disappeared, but soon returned. Aspiration was again resorted to a number of times, and this being so successful, the apparent conclusion was that aspiration with injection of iodoform emulsion would effect a cure. This was done and the patient died in a few hours.

When the brain was removed, nothing was seen on the surface, but on bisecting the right hemisphere, a large, soft growth, broken down and cystic in the center, was seen. It occupied about half of the hemisphere, was subcortical, but had become so nearly cortical that in handling it, before it got into my hands, the very thin layer of cortex covering the tumor was broken through. The point that broke through was exactly in the arm center. The tumor was a glioma. The case illustrates how brain tumor may, for a time, simulate hysteria; how a subcortical growth may cause typical Jacksonian attacks; what an enormous neoplasm will sometimes be tolerated in the brain; and what marked relief may be afforded in cases of nonspecific tumor by the administration of large doses of potassium iodid.

Errors of diagnosis are often made by giving the symptoms incorrect perspective. This cannot be better illustrated than by the following case:

PATRICK, HUGH T. (Jour. Am. Med. Assn., July 29, 1899, p. 283). *Operable glioma of the cortex of the parietal lobe diagnosed as deep in temporo-sphenoidal lobe; death; autopsy.*

The history of the case is that of a middle-aged traveling man, who first noticed in the summer of 1898 that he was a little more nervous than he should have been; that he was a little dizzy at times; and particularly that he had trouble in making out his reports accurately. In sending in accounts and orders, and in making up papers of any kind, or in keeping books, he was apt to make errors. When his physician related the case to me, I concluded that it was probably one of general paresis. There was a history of a little dizziness, some nervousness, impairment of memory, inaccuracy in making up accounts, and finally, the patient had several fits. He had at first what appeared to be fainting spells, and finally general convulsions. For two or three months previous to the onset of these convulsions he had trouble in reading and writing. On examination, several interesting conditions were found, among them weakness on one side of the body, homonomous hemianopia, word-blindness, motor aphasia, and double choked disc. Vision was rather poor, which might have been ascribed to the optic neuritis, but the difficulty in reading was clearly due more to word-blindness than to failure of vision. When I saw him the motor aphasia was more pronounced than the sensory (visual) aphasia, which led me to make a mistake as to localization. I got the Wernicke sign, and from this, with

the motor aphasia, I concluded that he had a tumor in the temporo-sphenoidal lobe, deep in, but near enough to the base to compress the optic tracts. This was a mistake. At the postmortem a subcortical tumor was found in the parietal lobe, extending back as far as the parieto-occipital fissure, and forward almost as far as the operculum. If I had paid more attention to his word-blindness, and less to motor aphasia, I would have located the growth farther back. Dr. Herzog has made a microscopic examination and it, like the other two, is a glioma.

The following case illustrates a difficulty which no amount of experience can remove or provide against:

PATRICK, HUGH T. (Jour. Am. Med. Assn., July 29, 1899, p. 282). *Tumor of the brain without definite local diagnosis; death; autopsy; small glioma resembling the normal brain substance.*

The first symptom of brain tumor in this case was a typical Jacksonian fit affecting the left arm. The patient was carrying something at the time and was about to open her door, when she had a convulsion, limited to the arm. Soon after she had another, attended with loss of consciousness. After this the fits were confusing; they were often of the general character of a petit mal, and after she was under observation for some time, and we obtained a more distinct and clear history of these fits, it was found that they sometimes began on one side, and sometimes on the other. The patient was about forty years of age. When I first saw her, I thought it was

more likely a case of brain tumor than anything else, and that was about all any one was justified in saying. There was at that time a little difference in the deep reflexes of the upper extremities. I saw her again some time later, and was reasonably sure that choked disc was developing. This woman had distinct mental symptoms; after a short time her memory became impaired; she had more or less mental hebetude; was nervous and depressed. How much the epileptoid attacks had to do with the mental deterioration I do not know; but she finally died. Dr. Haven, of Lake Forest, obtained a postmortem examination, and sent the brain to me.

The tumor was a little smaller than the last joint of one's thumb, and it was a question when the brain was cut whether it was a tumor at all. It has since been examined microscopically, and found to be a glioma. It was subcortical, and located, not in the arm center, but in that for the leg, or perhaps came down to the junction of the leg with the arm center in front of the fissure of Rolando. I had located it behind the fissure of Rolando. It had not reached the surface. Could it have been located during life and operated upon, I believe the tumor could not have been recognized by an incision in the brain. It was with great difficulty that it was recognized postmortem, the appearance being as much like a slight ecchymosis as anything else. In structure and consistency the growth was scarcely to be distinguished from normal gray matter of the cortex, and with the hemorrhage inseparable from an operation, I am convinced no difference could have been seen. From this little tumor at the

vertex the patient's condition was very like that of brain syphilis; there was a sort of hebetude; she was sleepy and dull; she could be aroused and would answer rationally, or sometimes a very little at random, a condition so frequently found in syphilis of the brain. She was given large doses of iodid and mercury to no purpose, and this may have contributed to her great prostration, but medication was withdrawn some weeks before death. It is incomprehensible how a small tumor like this could cause pronounced symptoms for a long time, and finally death.

The present case also shows how a tumor located directly in the motor area may cause no appreciable paralysis, and may give rise not only to general epileptoid attacks, but to fits beginning distinctly on the same side of the body.

There is another interesting point connected with the case. Here was a small tumor of the convexity which infiltrated the brain substance, and caused no displacement, and it is not easy to see how it could cause increase of pressure, yet the patient had optic neuritis. I could compare this, for instance, with a tumor case in which I missed the diagnosis, largely on account of the absence of optic neuritis, and also because of the known fact that the man had had syphilis, with unmistakable skin lesions. When, with other brain symptoms, he began to have typical Jacksonian fits, the supposition was that he had syphilitic trouble near the face center, the face and tongue being more affected, sometimes exclusively. But he was treated with heroic doses of specific remedies to no purpose. He then returned to another city, whence

he came to see me, and where he had been treated for epilepsy by antipyrin, with some benefit. One day he fell dead on the street, and at the postmortem examination, a tumor the size of a hen's egg was found in the face center. This man had no optic neuritis, and yet when I saw him he must have had a tumor not only four or five times as large as that in the preceding case, but located much nearer the base of the brain and the optic tracts, where it would be much more apt to cause choked disc.

DURATION

The duration of life with tumor of the brain varies between a few weeks and four to six years. In a few instances the tumor has produced no symptoms until a few days before death, as in a case observed by Patrick. There was a history of vomiting and severe stomach trouble following a period when the patient had over indulged; headache, foul breath, loss of appetite, and prostration. The headaches required morphine, and after it had been used some two days the patient became comatose and died as if from morphine, but really from brain tumor Then the wife remembered the gradual loss of strength in one arm, and the appropriate mental conditions were recalled by the attending physician. Death supposedly from morphine is frequently found to be due to brain tumor, as in a case observed by Sidney Kuh, in which the diagnosis was tumor of the liver, and death from an overdose of morphine. A tumor of the cerebellum as large as a hen's egg was found postmortem with several tumors of the liver.

Almost without exception the course of tumor of the brain is *chronic, progressive, and fatal.* There are two exceptions to this rule: syphilitic tumors favorably located, which may not prove fatal if properly treated; and some other tumors, such as glioma, which may terminate acutely.

NAMMACK, CHARLES E. (N. Y. Med. Jour., Feb. 16, 1895). *Gliosarcoma involving both optic thalami.*

Abraham K., aged 23, a Russian furrier, was brought in an ambulance November 3, 1894, in a condition of profound coma. Of his family or his previous history nothing could be learned from his shopmates, except that for three days previously he had complained of headache and diarrhea.

On examination he was found pale and emaciated. The tongue was dry, brown, and fissured. Pupils symmetrically contracted. Eyeball on the right side slightly protruded. Evidence of recent blistering on the nape of the neck. Moist râles in the lungs. No cardiac murmur. Urine drawn by catheter showed a trace of albumin. Paralysis of motion on the right side. Sensation preserved on that side, as shown by efforts made with the left hand to remove irritation caused by pricking of a pin. Temperature, on admission, 100.4° per rectum, ten hours later it rose to 104.8°, and thereafter fluctuated irregularly until death occurred, six days after admission. Pulse on admission was 90, and steadily increased until it reached 160, in the last thirty hours of life. Respirations ranged from 26 to 56. These latter changes were coincident with the development and progress of a

pneumonia of the right lung. The case presented many of the features of another observed in the hospital a year before, in the Medical Record of December 2, 1893, in which the autopsy had shown extensive hemorrhage, due to syphilitic arteritis, in a young man of twenty-two. It was thought that the same pathological condition was present in this patient. The brain was therefore sent to the pathological laboratory of the New York Hospital, and the writer is indebted to Dr. George P. Biggs for the following report:

"The brain is inclosed in its dura mater, and has been in weak alcohol a short time. The dura and pia appear normal. There is a very slight flattening of the convolutions of both hemispheres and marked bulging of the floor of the interpeduncular space. The lateral ventricles are greatly dilated, contain serous fluid, and measure, when freely laid open, eleven centimeters and a half in length, and five centimeters and a half in width. The ependyma of the outer portion of the floor of each lateral ventricle is opaque. Upon removing the corpus callosum and fornix, a soft, smooth, grayish tumor is found, completely filling the third ventricle and the aqueduct of Sylvius, and blending with the optic thalamus on each side so as to form a bridge between them on a level with their superior surfaces. The tumor lies beneath the velum interpositum, and is attached to it only over a small area, one centimeter in diameter, near its center. At the point of attachment the velum is a little thickened, but is elsewhere perfectly normal in appearance. Aside from the velum, the tumor has connection only

with the upper half of the inner surface of each optic thalamus, and there is not the slightest difference in the extent or completeness of the union on the two sides.

"The tumor measures six centimeters antero-posteriorly, three centimeters transversely, and two centimeters vertically.

"The left gyrus fornicatus, at a point near the posterior termination of the corpus callosum, is a little firmer than the surrounding tissue, and contains a few punctate hemorrhages.

"Sections of the tumor in the third ventricle show it to be a very vascular gliosarcoma, the cells of which are mainly round or ovoid, and of medium size. Granular intercellular substance is fairly abundant, but very few distinct gliomatous cells can be seen. Some of the blood channels have distinct walls, but most of them are simple canals in the tumor tissue. The velum interpositum, at the site of its attachment to the tumor, is infiltrated with cells of the same character as those forming the tumor. The hardened area in the left gyrus fornicatus presents hemorrhages of considerable size, and great thickening of its capillary vessels, due to development in them of cells like those of the tumor. A few such cells are also to be found in the pia over this area.

"It is impossible to determine the seat of primary development of this tumor. Judging from the extent of attachment it would seem quite possible that the process might have commenced in both optic thalami, and the tumors later united in the median line; or it

might have started in the velum interpositum. Development from the walls of the capillary vessels is clearly shown by a study of the more recent tumor in the gyrus fornicatus."

STEWART, JAMES (Phil. Med. Jour., May 27, 1899, pp. 1169-1170). *Perithelial angiosarcoma of the pituitary body. Symptoms: headache, vomiting, and temporal hemianopsia; finally infiltration of the growth into the ethmoid and sphenoid cells, causing hemorrhage from the nares; no symptoms of acromegaly, or other forms of nutritional disturbance.*

Miss K., age 35, a miniature-painter, was admitted on December 2, 1898, complaining of headache, dimness of vision, and occasional vomiting. She said the headache and dimness of vision had been troublesome for upward of eighteen months. The failure of vision was noticed first in the left eye, and she observed that the pupil of this eye was larger than the right. Three months previous to admission the sight of the right eye was found to be failing also, the pupil of that eye becoming larger. The vomiting, which occurs about every month, lasting from one to three days, was first noticed in March, 1898.

She was born in eastern Ontario, and always lived there, except for a period of six years, when she resided in Illinois. With the exception of measles and whooping cough, there was no history of any illness. She had four brothers and five sisters living, all in good health. One brother died from pulmonary tuberculosis, and a sister from heart trouble. She was much worried for months previous to the onset of the head-

ache and dimness of vision, and had been treated for nervous prostration.

She was a tall and well-nourished woman. Was able to walk about, but preferred lying in bed on her back, as in that position she suffered less from headaches. She was more than ordinarily intelligent, her mental state on admission being, so far as she or others could judge, fully normal.

Pain in the head was her great complaint. It was referred chiefly to (1) the left temporal and parietal regions; to the left eyeball, and over the left brow; (2) to the occiput, just below the occipital protuberance, shooting downwards and often forwards, on both sides, often encircling the neck. The pain, she said, was continuous, but was frequently intensified, especially on movement, on percussion, and at times spontaneously.

Three months before her admission into the hospital, Dr. Stirling had an opportunity of examining her eyes, and found the following condition present:

Right eye.—5-9, outer half of the field gone, light perception reduced five degrees. The pupil active to light and accommodation, but indirect action from left eye lost.

Left eye.—Light perception reduced eight degrees. She was able to count fingers at two feet in the lower and outer part of the field, but nowhere else. Pupil was seven millimeters in diameter, immobile to light and accommodation. There was a slight nonparalytic divergence.

There was simple atrophy of both optic nerves, without any diminution in the size of the large vessels.

Three months afterwards, Dr. Buller found a more advanced condition of atrophy, there being just perception of light in the left eye, and a marked diminution now all over the right field. He also reported a state of simple atrophy without diminution of the large vessels. The diminution of light perception in the right eye was so marked that he was not able to map out the field.

Her voluntary power was not in any way impaired. Nutrition was good. The knee jerks were much diminished, while the superficial and organic reflexes were normal. There was no disturbance of any form of the muscular sense. The general sensibility was not in any degree impaired, and with the exception of the disturbance in the functions of the optic nerves referred to, the special sense nerves were normal.

Menstruation began when she was thirteen years old, and continued one year, when it permanently ceased.

The urine had a specific gravity of 1.025, and contained one-half per cent of albumin, together with numerous granular and hyalin casts.

The subsequent course was characterized by more or less continuous and severe headache, by occasional vomiting, and gradually increasing stupor. A few days previous to her death, January 7, 1899, there was a discharge of a bloody fluid from both the anterior and posterior nares. The immediate cause of her death was hyperpyrexia.

A. G. Nicholls, assistant pathologist of Royal Victoria Hospital, gave the following account of the post-mortem:

"There was a subacute diffuse nephritis in both kidneys. The uterus was infantile in type, being only 5.25 centimeters long. The ovaries were small, fusiform in shape, and without noticeable scarring, and slightly fibroid.

"Examination of the brain showed the calvarium to be normal. The dura was thin, showing the convolutions of the brain through its substance. It was congested and exuded blood. The convolutions were flattened on both sides, chiefly over the vertex and posteriorly. The frontal convolutions appeared to be normal. There was considerable exudation of clear fluid about the base of the brain.

"On removing the brain a tumor-mass was found at the base, lying in the sella turcica, and occupying the site of the pituitary body, of which no vestige could be seen. The tumor measured 5 centimeters long by 4.75 centimeters broad. The upper surface was lobulated, forming grape-like masses of a reddish translucent color, of soft consistence, and hemorrhagic appearance. There were two large lateral lobes with three smaller ones anteriorly. The under surface of the tumor was very soft and diffluent, of the appearance of raspberry jelly. This was probably due to manipulation. The tumor lay in the median line with a tendency to the left side. There was an oval excavation on the base of the brain, in which the mass rested. The sella turcica was greatly enlarged in all directions, corresponding to the main mass of the tumor below. The body of the sphenoid was eroded from pressure, the bone being as thin as paper. The sphenoidal and ethmoidal cells contained a jelly-like

mass similar to the tumor. The posterior nares contained blood-stained mucus. On the left side in front, the tumor passed beneath the dura of the cranial base, reaching along the lesser wing of the sphenoid as far as back of the left orbit. It had not, however, invaded the orbit. The growth had reached the top of the pharynx without causing any perceptible bulging. The tumor pressed directly upon the optic commissure, which was flattened. It reached backward to a point two centimeters anteriorly to the pons, compressing the left crus. Other cranial nerves seemed not to be directly involved."

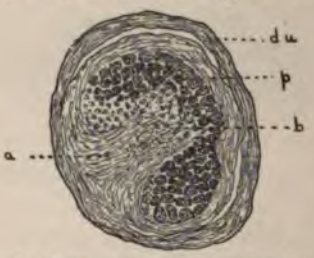
81. Longitudinal section through the head of the optic nerve, showing choked disc. The optic disc is swollen and the vessels are engorged: a, the retina; b, the choroid; c, the sclera; d, the dural sheath; p, the pial sheath; ar, the arachnoid space.

The specimen was hardened in bulk in formol-Müller.

At closer inspection the mass was found to be bounded, at least above, by a thin fibrous membrane, presumably the pia mater. Several sections were made through its substance, and through the optic chiasm, pons, medulla, left crus, and cord.

Microscopically, the tumor was found to be inclosed in the upper surface by a laminated fibrous tissue membrane, presumably the pia mater. The finer structure of the mass varied somewhat in different parts. In the main, it consisted of delicate capillary blood-vessels with elongated cells, having oat-shaped nuclei. The blood-vessels were composed

of a basement membrane, lined with flat endothelial cells; they were for the most part small, but in a few instances formed actual cavernous sinuses. The elongated cells were arranged about the blood-vessels, their long axes being placed radially to the center of the vessel. This gave the tumor the appearance of being formed of a series of rings. In other places the elongated cells formed long, finger-like processes, running in various directions, and without the same definite relationship to the vessels. On the under surface of the tumor small spicules of bone were seen, showing that the new growth had forced its way through the body of the sphenoid. At the margin of the growth two or three very cellular nodules were seen, which had a close resemblance to round-celled sarcoma. On the whole, as the tumor was composed largely of short spindle cells, it had the appearance of a sarcoma, and owing to the relationship to the vessels, it must have started from the perithelium. No remains of the pituitary body were seen, nor was colloid present.



82. Cross section of optic nerve about one millimeter behind the eyeball. (× fifteen diameters.) Healthy nerve fibers are in black; the atrophied portions and connective tissue of the sheath are in white. a, atrophied nerve; b, nerve fibers partially atrophied; du, dural; p, pial sheath.

A diagnosis of perithelial angiosarcoma of the pituitary body was made.

Sections through the optic chiasm showed that the optic nerves were in a state of extensive degeneration, the myelin-sheaths being broken up and reduced to

globular masses. The blood-vessels were distended, and surrounding them were masses of small round cells.

Sections through the pons, medulla, left crus, and cord showed nothing abnormal.

The symptoms in this case extended over a period of about twenty months, and were clearly indicative of a cerebral growth in the neighborhood of the optic chiasm. There were no symptoms whatever of acromegaly, myxedema, or pernicious anemia. I would like, however, to call attention to two changes which have been frequently met in cases of tumors involving the pituitary body.

These are cirrhotic changes in the kidneys, uterus, and ovaries. Boyce, in his valuable paper on hypophysial growths, gives details of at least four cases in which the kidneys were found to be granular.

STEWART, JAMES (Phil. Med. Jour., May 27, 1899, pp. 1170, 1171, 1172). *Endothelioma of the base of the brain, causing pressure on the chiasma, and obliterating the pituitary body; symptoms of a cerebral growth extending over nine years; right temporal hemianopsia; profound anemia; a general appearance not unlike that seen in myxedema; no change in the osseous tissues.*

Mr. W., a merchant, aged 42, came first under the observation of Dr. Stirling in February, 1888, complaining of headache, failing vision, and vertigo. He first noticed the failure of vision in the left eye two years previously, and this was the first evidence of any intracranial trouble.

He had been for a number of years, and up to the

time of the appearance of his present complaints, a heavy drinker. There was no history or evidence of tuberculosis or syphilis. He complained of a dull frontal headache, but neither at this period nor any time during the prolonged course of his illness was headache a prominent symptom. In walking he had more or less constantly what he called a giddy sensation, with a tendency to fall forwards. Vomiting of a cerebral character was present for some months during the early period of the disease. Dr. Stirling's examination of the eyes revealed the following changes:

Left eye.—There was no perception of light. The pupil was semidilated and immobile, but reacted on stimulating the right eye with light.

Right eye.—Complete blindness to the outer side of the field. The inner side was amblyopic, vision being reduced to counting fingers at twelve feet. In reading type he was able to pick out a letter of the largest size (No. 16) here and there. In this area the perception of green was found to be very defective, and after looking at green for some time, there was an after-image in pink.

Examination of the fundus revealed in the left eye white atrophy of the disc with somewhat contracted vessels. In the right eye the disc was pale.

There was no objective disturbance of either sensation or motion. He complained, however, of numbness in the hands. He had frequent flushings, followed by profuse perspiration about the head and neck. The knee jerks were slightly exaggerated, but the superficial and organic reflexes were normal.

The further course of this case was very slow, six

years elapsing before his death in 1894. His sight entirely failed in August, 1889. He became very fat and anemic. The face and extremities were puffy, but in no part was there pitting on pressure. The puffy, pale skin presented a very striking clinical picture. The pallor of the skin was noticed when he first came under observation in 1888, but it steadily increased. In 1892 he presented the typical appearance of a person suffering from pernicious anemia, the skin having a typical lemon-yellow tint, while the general state of nutrition appeared to be unusually good. In March, 1893, Dr. Gunn examined the blood. He found 2,800,000 red cells, and the proportion of white to red as one to 1,500. The red cells were irregular in size, microcytes being abundant. No nucleated cells were found. Four months later a second examination of the blood was made by Dr. Gunn. He found 2,100,000 red cells, and the proportion of white to red as one to 1,600. The urine was free from both albumin and sugar.

The anemia remained up to death, but did not present any changes different from the last above recorded examination. His appetite remained good, and was at times even voracious. He was annoyed with photopsia, and during the last two years of his life he complained more or less constantly of hallucinations of vision, smell, taste, and hearing, and of general sensibility. He often imagined that burglars were breaking into the house, maintaining that he not only heard but saw them. He kept a revolver under his pillow to punish any burglar that would attempt to come near him.

He frequently made mention of what he called "beasties" crawling over his skin, and would stoutly maintain that he not only felt but saw them. This was when he had no perception of light in either eye. Although his general nutrition and strength were fair, he spent almost the whole of his last year in bed. When urged to get up he would make answer that he would do so on the following day.

SUMMARY OF THE SYMPTOMS AND COURSE

1. Gradual loss of vision in both eyes, going on to total blindness in the left and temporal hemianopsia in the right, followed later on by total extinction of the perception of light.

2. There was complaint in the earlier months of his illness of frontal headache and of occasional vomiting.

3. The presence of more or less constant giddiness throughout the course of his disease, with a tendency at first to fall forwards, and afterwards to one side.

4. Profuse intermittent flushing and perspiration about the face and neck, the skin of other parts being dry and harsh.

5. Tardy cerebration, as evidenced by a slow, drawling speech, and delay in answering questions. There was also great apathy and drowsiness, and lowered temperature.

6. Hallucinations of sight, smell, of hearing, and of general sensibility

7. A very pronounced lemon-tint of the skin, resembling, in this respect, the appearances considered to be characteristic of pernicious anemia. The blood-

changes corresponded also to those met with in pernicious anemia.

8. Edematous-like condition of the hands and feet, but no pitting on pressure.

9. During the last two years of his life he kept his bed more or less constantly, taking little or no interest in anything, but still able to talk and answer questions intelligently. He finally died in a state of coma.

The general symptoms, headache, vomiting, vertigo, and optic atrophy pointed clearly to a cerebral tumor, while the temporal hemianopsia localized this to the optic chiasm. Had the visual disturbance been seen earlier it is highly probable the limitation of the field would have been met in both eyes. The absence of the pupillary reflex indicated that the lesion must have been situated between the left eye and the basal optic nuclei. Further, the optic atrophy showed that the lesion could not be further back than the basal nuclei, as in lesions of the optic radiations or cortex, white or essential atrophy is very rarely if ever visible at the optic disc. The slow growth of the tumor would account for the absence of choked disc, time being sufficient to allow for the formation of lateral drainage or gradual distention of the sheath.

When the patient was first examined the obtunding of the nasal half of the light field, together with the defective perception of green, pointed to interference with the conduction of the remaining active portion of this nerve. There was a concentric and a fairly equal contraction of the field for white and colors, pointing to a slow growth.

Professor Adami, who performed the postmortem,

found a large cancerous tumor of the pituitary. The bone in the neighborhood was found greatly atrophied and the fossa greatly enlarged.

As the diagram shows, the growth was not perfectly symmetrical, extending more to the left than to the right hand side. The right olfactory was pushed to one side, while the growth infiltrated anteriorly above the left olfactory nerve. The thyroid gland was found to be normal. Dr. Nicholls reported as follows on the nature of the growth:

83. Endothelioma of the hypophysis.

"The portion of the tumor examined was inclosed in a laminated fibrous-tissue capsule in the pia mater. The tumor was composed of rounded or oval masses of cells surrounded by loose connective tissue, the whole at first sight suggesting carcinoma simplex. On examining more closely, however, it was seen that the cells did not conform to the carcinoma type. The walls of connective tissue which inclosed the cellular mass were lined with elongated and flattened cells, fusiform when viewed edgewise. At other places, when the section was more oblique, these cells could be seen to be irregularly diamond-shaped, with large clear oval nuclei: typical endothelial cells. The cells forming the cell masses were various in shape, being generally elongated with bluntly oval nuclei; others, however, being irregular in outline with a more rounded nucleus. They had in places a curious tendency to form small whorls, and in such cases the component

cells were considerably flattened. The tumor was not especially vascular, nor did it show any tendency to degeneration. No pituitary structure was seen."

The diagnosis made was that of endothelioma.

The general symptoms of an intracranial growth, as headache, vomiting, vertigo, optic atrophy, were sufficiently pronounced to allow such a diagnosis, and the locality of the growth was clearly indicated by the temporal hemianopsia. An especial interest arises in connection with an explanation of the myxedema-like state and the pallor of the skin. How are these conditions to be explained? Have they any connection with the destruction of the pituitary body?

GLYCOSURIA CONSECUTIVE TO EXTIRPATION OF PITUITARY GLAND

Extensive experimental research on dogs has demonstrated that partial or total resection of the cerebral hypophysis produces, besides the inevitable cachexia, a pronounced and persistent glycosuria, accompanied by polyuria. Caselli observes in his preliminary communication to the Rivista Sperim, di Freniatria xxvi, 1, that this result agrees with the clinical observation that glycosuria is frequent in cases of a tumor in the pituitary gland with or without acromegaly.

LITERATURE

The literature of tumor of the brain is one of the most extensive in medicine. It can be studied from the index catalogue of the Surgeon-General's Library, from the text-books of pathology, neurology, and surgery, especially in the monographs on brain tumor. Notice especially Starr, M. Allen,

Brain Surgery, New York, 1893; Bramwell, Intracranial Tumors, London, 1888, et seq.; Gowers, Diseases of the Nervous System, 1888; Knapp, The Pathology, Diagnosis, and Treatment of Intracranial Growths, Boston, 1891; Oppenheim, Die Geschwulste des Gehirns, Berlin, 1896, pp. 257 to 271; von Bergmann, Die Chirurgische Behandlung von Hirnkrankheiten, Berlin, 1899. The current literature can be studied from the indices of the Annals of Surgery (Brain), the Journal of Medical Sciences, the Journal of Nervous and Mental Diseases, the Alienist and Neurologist, and the Centrallblatt für Nervenheilkunde und Psychiatrie. Abstracts of the current literature can be found in Gould's Annual, Virchow und Hirsch's Jahresbericht, the Journal of the American Medical Association, American Medicine, and the Philadelphia Medical Journal.

Weeks, John E. The Papillitis Accompanying Brain Tumor. Journal of the American Medical Association, December, 1899.

CHAPTER XII

EPILEPSY, PACHYMENINGITIS, AND INSANITY

Limitation of epilepsy; traumatic epilepsy; results of surgical treatment in olden times; modern results; general review of statistics; illustrative cases; conclusions. Pachymeningitis hemorrhagica interna; definition; limitation; historical review; recent operations; conclusions. Insanity; the limitations of surgery; disappointing results; illustrative cases. Headache; erroneous diagnosis of tumor. Cerebro-spinal meningitis.

Epilepsy is a term applied to a clinical manifestation which presents itself in a variety of forms, and is the result of a variety of causes, of which only a few are even partially understood. When it is the immediate result of an injury to the skull, it may sometimes be treated with success by surgical procedure. When it is the result of an accessible tumor of the brain, the removal of the tumor should certainly be attempted. There is no clinical condition which places the patient in so helpless and embarrassing a position as epilepsy. It usually follows a progressive course, and either in itself or as a result of poisonous remedies used to check its manifestations, destroys mental equilibrium, and soon unfits the sufferer for any family, social, or business relations. The surgeon is therefore frequently implored to attempt the relief of these cases,

and he is tempted to do so, even when his judgment contradicts any hope of cure.

The only cases of epilepsy in which surgical interference is justified are those directly consequent upon trauma, and those in which the symptoms point to a local, accessible site of irritation. This form is usually termed Jacksonian epilepsy, but every case of Jacksonian epilepsy is not a hopeful case for operation. Even the fact that a Jacksonian epilepsy follows more or less directly an injury over the appropriate area cannot be looked upon as warranting a prognosis of permanent benefit, dependent upon operation. To the clinician, indeed, it is a well-established fact that any manner of surgical operation, upon any part of the body, is followed in epileptics either by temporary cessation of the seizures, or by a period in which their severity is somewhat diminished; but not by lasting relief. (Maclaren, Edinburgh Med. Jour., January, 1875.) Even such spectacular procedure as the exhibition of the actual cautery has gained, in the hands of the charlatan, no small fame as an alleviating agency in this disease.

The entire statistical literature of epilepsy is vitiated by the early reports of recoveries after operation, which were in fact mere instances of temporary relief; the same patient often returning two and three times for surgical treatment, each operation being added to the medical literature of successful trephining. Douglas, in 1883, reported 296 operations for the relief of epilepsy, with 179 recoveries; and Walsham, in the same year, reported 69 operations in St. Bartholomew's Hospital, with 48 recoveries, 17 im-

provements, and only 4 failures. These statistics are not to be relied upon. There can be no doubt that the patients lived, nor that during the time they were in the hospital they showed improvement, or apparent recovery; but experience compels us to think that observation of these so successful cases, extended over a brief term of years subsequent to operation, would have witnessed a return of the epileptic fits in many instances, and that with increased severity. For these reasons all statistics of recent cases, in which improvement and recovery follow trephining for epilepsy, should be regarded by the student with critical reserve. Only by the lapse of time, with failure of the disease to recur, can the claims of such reports be justified.

The origin of epilepsy, even after injury to the skull, is wholly a matter of conjecture. It has been attributed to scar formation in the glia tissue of the cortex, and it is often attended by the presence of a scar reaching from the dura through the pia into the cortical substance, and even into the medulla of the brain and cord. This scar formation seems to be analogous to the keloids of the skin, but many cases are found in which the scar is absent, and the only evidence of injury is a thickening of the dura, and an unusually close attachment between the dura and the pia. In other cases all these evidences are wanting. Epilepsy does not seem to follow suppurating wounds of the skull more frequently than simple fractures, and there is no single etiological factor to which this manifestation can be attributed. Spiculæ of bone have sometimes been found detached from the skull and occupying a place in the motor area of the cortex cor-

responding to the musculature involved in the initiating symptom of Jacksonian epilepsy. The bone has been removed and recovery has followed. In some such cases the recovery seems to have been permanent, and ten or fifteen years have passed without a relapse; but in the great majority of cases in from one to four years, or even less, the seizures recur. In certain other cases the spicula of bone has remained attached to the skull, but it has wounded or penetrated the dura, and is surrounded by a progressive scar formation. The results of excision are in nowise different from those already noted.

When adhesions are broken up between the skull and the dura, or between the dura and the pia, they quickly reform after the operation; when a thickened dura is removed it is soon replaced, often by a thicker dura; when a scar in the cortex is excised its reappearance is certain to follow. The most conscientious, patient, and careful operators report but few recoveries after trephining for epilepsy.

Epilepsy follows injury to the skull much more frequently than injury to other parts of the body. This fact is well illustrated in the statistics of the Civil and Franco-Prussian wars. von Bergmann, in the report of the Imperial Minister of War, finds 63 epileptic invalids among those injured, of whom 46 had suffered wounds of the head, and 17 wounds of the body or extremities; and in 8,985 viable cases of gunshot wounds of the head there were 46 epileptics, while in 77,461 wounds of other parts of the body there were 17 epileptics; in the first group a percentage of 0.57, and in the second of 0.076. Of 167 surviving

pensioners of the Civil War who suffered injuries of the skull, 23, or 13.7%, were epileptics. Eccheverria collected 783 cases of epilepsy, of which 63, or less than one-tenth, could be referred to a traumatic origin. This is a larger per cent than is given by most authors. Among the 1,295 epileptics considered in Rutter's report (The Bulletin of the Ohio Hospital for Epileptics, December, 1898), 49 different causes were alleged as responsible for the affection, while 839 were referred to as "cause unknown."

In more than 27% of all cases the disease appears to be congenital; in 41% it manifests itself before the tenth year of age. Some cases seem to be due to congenital defects in the arterial system, and the thymus gland; but most often there is no assignable cause. Among children who have required instrumental delivery, and among those who have suffered severe attacks of the infectious diseases, epilepsy is found in larger proportion than among those who endured a natural birth, or whom the infectious diseases spared altogether or touched but lightly. Epilepsy is known to follow scars upon the trunk or extremities, and in such cases injury to the scar induces an epileptic seizure. Excision of the scar gives relief for a time, but recurrences are frequent. Abnormalities in the nose, foreign bodies in the ear, and infection of the sinuses about the head often result in an epilepsy which is relieved or entirely cured by correcting the defect, removing the foreign body, or draining the sinuses. Depressed fractures of the skull have frequently given rise to an epilepsy

which has disappeared with the elevation of the fracture.

A consideration of the various forms of traumatic epilepsy, due to injuries of the head, shows each case falling naturally into one of three categories: those due to depressed fracture of the bone without apparent injury to the brain or its membranes; those cases accompanied by a thickening in the membranes; and those due to scar formation in the glia tissue of the brain itself. All these cases produce more or less definite localizing symptoms in Jacksonian epilepsy. Graf collected 92 cases in which the symptoms indicated scar formation in the meninges. In 82 instances the cicatrix was found in the dura and brain substance, and in 10 it was absent. Of the 71 cases operated upon, 4 resulted fatally, 25 were under observation so short a time as to possess no value, 20 were without decisive result, 22 were apparently cured at the end of one year, and but 4 exhibited no recurrence of the disease at the end of four years. In Braun's table of 47 operable cases, 3 resulted fatally, 11 were made worse, 11 showed no improvement, and 22 were reported cured. In 55 of Graf's cases in which the cortex was occupied by a scar, a cyst, or a splinter of bone, 5 died of the operation, in 8 the condition remained unchanged, 6 were improved, and 16 recovered; but of these only 14 were under observation for more than a year. Starr sums up the results of his studies in epilepsy by saying that while some patients are beyond doubt cured, the results of trephining are in general disappointing.

The surgeon will, however, frequently be tempted

to operate, and the temporary cessation of the seizures which follows such procedure would seem to warrant it. I once operated upon a half-breed Indian in the County Hospital, who was having fits so often that his condition amounted practically to a status epilepticus. His attacks were typically Jacksonian in their onset, but became general, and ended in a powerful, protracted convulsion and coma. There was a distinct aura, promptly followed by a progressive contraction of the right hand, arm, shoulder, and face. On the left side of the head, over the fissure of Rolando, was found a considerable scar as if from an old, infected scalp wound; but the only history of injury the patient gave was represented by a scar in the region of the occiput. Trephine openings were made as if to approach the arm center, and without regard to the scars. The dura was found intact, and puncture failed to discover the presence of a cyst, or other substance of a tension different from the brain itself. The buttons were not replaced. The skull was next opened under the scar on the occiput, and here also nothing abnormal was found. There was prompt recovery from the operation, and after the first night the patient had no fits. He was about the wards in the capacity of orderly during the next six months, and then drifted out of the hospital and beyond my observation. Two years later I received a letter from Roswell Park, stating that the man had come into his care at Buffalo, seeking surgical relief. His epileptic attacks had returned with as great frequency and severity as before operation.

In yet another case the apparent recovery was still

more pronounced and marvelous. The patient was a negro veteran of the Civil War, who had received a head injury from a fragment of shell; the wound had never been given any attention. For the past twenty years there had been progressively frequent and severe epileptic attacks. During the year prior to my first knowledge of him, these attacks had been such as to prevent him following his trade of paper-hanging. When he entered the hospital of the Medical Missionary College, in November of 1901, he was suffering as many as eight or ten fits each day, and his mind was clouded in the intervals. Under a strict vegetarian diet, with hydrotherapeutic treatment of various kinds, he grew steadily worse, and especially during the night his fits were of the greatest severity. They began uniformly with contracture and pain in the right shoulder, and ended in the most violent convulsion and coma. Profuse bleeding at the nose was commonly present during the height of the convulsions, and when he had become almost cyanotic. During the week preceding Christmas he averaged nineteen convulsions each night.

Although I gave the most doleful prognosis, the patient's friends decided in favor of an operation, which was attempted the Sunday following Christmas. A large osteoplastic flap was turned down from over the fissure of Rolando. The DeVilbis rongeur was used in making the bone flap, and by some mischance it cut through the dura and skull at the same time. After the elevation of the bone flap, the dura was easily separated from the pia, but no evidence of injury or scar formation in the brain could be observed.

The dura was sutured with catgut and the bone flap and overlying scalp secured in place. Recovery from the operation was perfect, and the patient had no further attacks during his hospital residence, nor, at the time of my last observation of him in the following spring, had there been any recurrence of the disease.

Epilepsy is so serious a disease, and it is so frequently followed or accompanied by those conditions we call insanity, that any arrest of the malady, not to say cure, would seem to warrant the greatest risk and the most uncertain procedure. If any operation is to be done upon the skull, it should be done early, and an attempt should be made to reduce the depressed fracture of the skull, to remove any effusion of blood in the membranes, and then to secure the utmost degree of rest and quiet for the patient. These measures will in the more fortunate cases bring about complete recovery, and forestall this terrible disease.

LITERATURE

The literature of epilepsy is unusually extensive. It must be studied in the texts of pathology, neurology, and medicine, and in the current numbers of Gould's, Sajou's, and Virchow and Hirsch's Jahresbericht. The Journal of the American Medical Association gives references to most American literature upon the subject. The following articles should be consulted:

Hughlings-Jackson. The Medical Times and Gazette, 1861-1862.

Hughlings-Jackson. The British Medical Journal, 1873.

Graf. Operative Behandlung der Epilepsie, Berlin, 1898.

Braun. Deutsche Zeitschrift für Chirurgie, Bd. 50, 1898, p. 223.

von Bergmann. Die chirurgische Behandlung der Hirnkrankheiten, Berlin, 1889, p. 386.

Eccheverria. Archive generales de medicine, 1878.

Van Geison. N. Y. Med. Record, April 29, 1893.

Bulletin of Ohio Hospital for Epileptics, 1898.

PACHYMENINGITIS HEMORRHAGICA INTERNA

Pachymeningitis hemorrhagica interna is a condition which presents itself in three distinct clinical groups. It is observed in children in the first months of life; in the course of general paresis; and in adult alcoholics. The condition was first recognized and described by Virchow, who ascribed it to some inflammatory process. It manifests itself in a meningitis which in the graver forms assumes the appearance of a considerable hemorrhage into the pia-arachnoid, and in the less severe cases by a fibrinous infiltration of the dura and pia. From a surgical standpoint only the pachymeningitis of sane adults is to be considered. It is not a common disease. Northrup mentions only four cases in 1,500 postmortems, and Osler states that during ten years in the Montreal General Hospital he saw not a single case, while he found four cases in the Philadelphia Hospital in three months. Monroe met with one instance in 1,000 autopsies in the Massachusetts General Hospital (0.1%).

The disease shows itself for the most part in adult males who are addicted to the excessive use of alcohol, and usually in those who have suffered of syphilitic disease. It is frequently initiated, or if not initiated the attention of the physician is at least directed to the condition, by a trauma. The patient is usually a man between the ages of forty and sixty-five. He has been habituated for many years to excessive alcoholism, and very frequently gives a history of one or two attacks of delirium tremens. He has had, during the preceding year or year and a half, one or two periods

of partial or complete unconsciousness; these seizures at their worst being accompanied by a temporary paralysis, usually of one side, and frequently of one limb. In the later and severer attacks there is often rigidity, and prolonged but intermittent unconsciousness or coma. At such times the paretic side is not uniformly the same, and the symptoms are irregular, interrupted, and almost anomalous.

The patient is frequently brought to the attention of the physician after having been found by the police and detained for a day or so on a suspicion of drunkenness; or he is brought to the hospital with a history of falling from a sidewalk or a moving train. In making the examination, such findings as a scalp wound, a fracture of the base of the skull, the presence of albumen and casts in the urine, or the fumes of alcohol on the breath may lead to an incorrect diagnosis. Uremia, fracture of the base of the skull, hemorrhage from the middle meningeal artery, concussion of the brain, and a simple alcoholic intoxication are all conditions which may be closely simulated by pachymeningitis. If the history of the patient is secured it will exhibit a record of habitual drunkenness with periods of mental and physical disability characteristic of pachymeningitis. Especially significant is the intermittent manifestation of the symptoms. It must not be forgotten that pachymeningitis is consistent with coincident fracture of the base, with chronic or acute nephritis, uremia, and intoxication.

Ceci, of Genoa, first undertook, in 1887, the surgical treatment of pachymeningitis hemorrhagica interna. The patient was a man fifty-two years of age. He

had received a slight injury over the right parietal region, which was allowed to heal without medical treatment. Two months later there appeared a rapidly advancing paralysis of the left side of the body initiated by a stiffness in the left foot, and progressing as far as to the tongue. There was incontinence of urine, and the patient was semi-comatose. The case presented the symptoms of an abscess of the brain in the motor area, and trephining was accordingly resorted to. Exposure of the dura showed it to be closely attached to the bone, greatly thickened, and of a dark blue color. It was incised and a mass of coagulum removed which extended over a considerable portion of the hemisphere. Exploratory puncture of the brain in several directions failed to discover any abscess formation. Recovery from the operation was rapid, and six months later there remained only a slight paralysis of the left hand.

This case lacks certain of the points most essential to a clinical diagnosis of pachymeningitis, but these deficiencies can be supplied by the memory of the student. Michaux, in 1891, presented an analogous case which was operated upon with equal success. The patient, a man thirty years old, was an habitual drunkard. For a year he had suffered with severe headaches, and on two occasions fainting spells had incapacitated him for work. He was found one day in a comatose condition, with pupils dilated. There was a slight bruise on the scalp, but no severer injury could be detected. There was a paralysis of the left facial nerve, and the left arm was motionless, while the right was thrown about. On the following day

the facial paralysis had somewhat diminished, but the left leg was paretic. The patient seemed a trifle aphasic, but was no longer comatose. Later in the day a convulsion came on, beginning at the left corner of the mouth, involving the entire musculature of the face, and extending down the arm to the thumb and index-finger of the left hand. The convulsion was repeated at intervals of fifteen minutes, involving in regular progression the areas named.

Michaux made three large trephine openings over the right fissure of Rolando. There was no extra-dural blood, but upon incision of the dura two table-spoonfuls of dark blood-clots were found and removed. On the following day the patient had one convulsion, after which they ceased altogether. At the end of four months there remained only a slight impediment of speech.

Bullard, in 1895, described a case in which he recommended operation, and later confirmed his diagnosis by a postmortem. Since that time he has observed, together with Monroe, 11 cases, in 3 of which neither the operation nor the postmortem established the diagnosis.

Monroe has operated upon one case with success, and upon several others unsuccessfully. In one of these latter cases he trephined upon the wrong side of the head, and in another he trephined upon both sides, but the patient died of a coincident fracture of the petrosa.

Barratt has made a careful study of the effusion in pachymeningitis hemorrhagica interna. His histological preparations show that the effused blood is firmly

held in the meshes of the pia-arachnoid. This accounts for the difficulty which all operators have experienced in removing the clots. Every effort to find micro-organisms in the clots, or to obtain cultures, or to secure a reaction in living animals, proved fruitless.

After a study of the literature of the subject, and his 11 cases, Monroe concluded that all patients in whom a relative diagnosis of pachymeningitis could be made should be operated on, and this whether the disease existed in its simple form, or complicated by delirium tremens, nephritis, uremia, or fracture of the skull; further, that if trephining upon one side did not restore the patient to consciousness, or to a greatly improved condition, the opposite side should in like manner be approached in spite of the lack of localizing symptoms.

LITERATURE

Osler. The Practice of Medicine.
Northrup. N. Y. Med. Record, Aug. 3, 1890, and May 10, 1890.
Duponchell. Le bulletin med., Aug. 5, 1880.
Goldsmith. Am. Jour. of Insanity, June, 1888.
Herter. Am. Jour. of Med. Sciences, Aug., 1898.
Monroe. Trans. of Chicago Medical Society, 1902.
Dauchez. La France medicale, Sept. 12, 1900.
von Bergmann. Die chirurgische Behandlung von Hirnkrankheiten, Berlin, 1899, p. 449.
Michaux, J. O.W. On Pachymeningitis Hemorrhagica Interna, Brain, part 2, 1902.

INSANITY

Among the relics of certain prehistoric peoples have been found skulls showing unmistakable signs of crude attempts at trephining. The procedure would seem

to have been accomplished by digging and scraping the skull with a flint instrument until it was opened and the dura revealed. The practice is supposed to have been a part of some religious rite, probably the preparation of the individual for a higher order of being, the demon through whose agency the change in the man was effected making its entrance by way of the hole in the skull. What is by some supposed to be a meaningless survival of this rite is the tonsure of certain orders of monks.

The early history of medicine shows that from the most ancient times physicians have noticed the causal relationship between injury of the head and insanity, and that simple trephining has been practiced as a remedy. The result of later observation has in nowise disproved the assumption that insanity frequently follows injury to the head. In 18,606 cases of insanity, 408 had suffered some head injury which was regarded as the cause of the disease; and in Stolper's collection of 981 cases of injuries of the head there were 12 instances of consequent mental aberration, or 1.2%. Almost all of these cases were the result of severe fractures of the vault or the base. In 2,200 cases of insanity noticed by Kernan, 45 were of traumatic origin, or over 2%. Hays, in 2,500 cases of insanity, found 61 of a similar nature. If we except from this list all instances save those in which a severe trauma was sustained, there remain 136 cases of head injuries with 11 cases of insanity, or 8%.

It is a well-established fact that injury to the head during birth may give rise to mental abnormalities. In Wolff's collection of 1,436 cases of idiocy, 198, or

13.4% had suffered some unusual traumatism at birth; but in 5% of these cases there were other factors contributing to the condition. In hospitals for the insane postmortems frequently reveal old fractures of the base, and injuries of the brain which had not appeared in the history, and which were not discovered by the physical examination.

The mental aberration which follows injury of the head seems to be due to compression and irritation of the brain by depressed fractures, to laceration of the dura and extravasation in the pia-arachnoid, to contusion and extravasation within the brain substance, and to scar formation in the glia tissue. This is a verbal expression of the relation between injury and insanity, but it stands for no real knowledge of actual cause and effect. As was pointed out in a previous chapter, psychical symptoms may accompany, or follow by a considerable interval, an injury to the brain. They are sometimes the most prominent of all symptoms in these cases. They are usually transient in character, but may persist, and the patient be sent without treatment of the head injury to an institution for the insane. When the psychic symptoms are late in appearing they usually advance by almost imperceptible gradations. As the confusion which follows the injury clears away, the mind of the patient is discovered to be perturbed and irrational. There is no characteristic peculiarity in the psychosis of head injury. It simulates every form of insanity. Schläger (Zeitschrift der k. k. Gesellschaft der Aerzte in Wien, 1857) reported 500 cases of traumatic insanity, of

which 19 presented evidence of dementia within the year following injury, while 4 patients showed no signs of aberration until ten years after the trauma.

The prognosis in traumatic insanity would seem to be most unfavorable. Trephining, or other surgical procedure, is of almost as little avail as in epilepsy. Nevertheless not a few cases have seemed to improve, and some actually to recover, under surgical treatment. Of such instances the following cases are classic examples:

CALE, GEORGE W. (N. Y. Med. Jour., Oct. 12, 1895.) *Traumatic insanity appearing four years after injury; operation; recovery.*

The patient was a man, twenty-six years of age, by occupation a carpenter. The family history presented no instances of insanity or other serious nervous disorder. He had always been in good health until June, 1885, when he received a blow from a club, the wound being midway between the fissure of Rolando and the external occipital protuberance, and slightly to the left of the median line. The wound was treated as an ordinary scalp wound, and it suppurated for three months.

Four years after the reception of the wound, the patient began to complain of severe pain in the left parietal and occipital regions of the head. He became extremely imaginative, and thought his family and friends were plotting against him. About this time he began to suffer attacks of petit mal. His manner and disposition became greatly changed for the worse, which is almost invariably the rule in these cases; he

was sullen, morose, and ungrateful. He would lie when it was decidedly to his advantage to be truthful, and he developed a mania for stealing.

On October 17, 1888, he was sent to the insane asylum at Anna, Illinois, where he remained for sixteen months. At the end of this time his condition seemed sufficiently improved to warrant his discharge. On returning home he soon reverted to his old rôle, and after a trial of ten months, the family were obliged to have him removed to the asylum, where he was detained for five months. He was again released, but only for one month. Four months later he was brought to me for treatment. This was in October, 1891.

A diagnosis of traumatic insanity was made, and an operation advised. To this the family readily assented, but the patient objected vigorously, and tried to run away before the time set for the operation.

The head was shaved and the usual antiseptic precautions were taken. To prevent loss of blood, and also for the purpose of keeping the field of operation clear, a piece of rubber tubing was tied around the head, passing above the eyes and ears and below the occiput. A large pear-shaped flap was made over the site of the adherent scar, the pedicle of the flap being downward toward the blood supply; this was elevated together with the periosteum, except a small portion which was attached to the bone at the site of injury. The bone was found to be somewhat depressed, as was also the corresponding portion of the internal table; a piece about the size of a silver quarter was removed. The dura appeared normal, although the

depression of the internal table was quite marked. The wound was closed after the insertion of a few strands of catgut for the purpose of drainage, and the usual dressings were applied. The change in the patient could be noticed as soon as tne effects of the chloroform had disappeared; his headache had vanished, and his manner was decidedly cheerful. His recovery was uninterrupted, and he left the hospital on the twelfth day after operation. Since that time (nearly four years) he has held a responsible position on a railroad, and is to-day in perfect health.

There are few cases reported that are as favorable and striking as this one. Even after what would seem to have been an adequate cause of the insanity has been removed, the symptoms may continue. The damage done the brain is deeper and more subtle than the surgeon's knife can repair. In the following case, in which epilepsy and insanity are combined, the reason for trephining was adequately demonstrated and the recovery was prompt and remarkably complete.

DAVIS, JOHN D. (Medical News, Nov. 9, 1895.) *Epileptiform convulsions complicated with insanity and paralysis.*

John H., aged 34 years, received, in October, 1892, a blow with a chair on the right parietal bone. He was rendered unconscious for several hours. After regaining consciousness he suffered from paroxysmal headaches, but it was not until the following January that his mind became so deranged that his friends found it necessary to relieve him of the care pertaining to his business. He was taken to a sanitarium at Lake Geneva for treatment, but his malady progressed,

and was augmented by attacks of epileptiform convulsions, which were of frequent occurrence and very severe. In February a gradual loss of power took place in the left arm, progressing until paralysis of the arm, forearm, and hand was complete. Following this was a partial paralysis of the left leg and thigh, particularly marked in the extensor muscles.

In April, 1893, the man was removed to an insane asylum, where he was confined until August 1st. All this time his symptoms were growing worse. Early in August he was removed to the home of his parents, in Allegheny City, Pennsylvania, and when I was called to see him, September 1, 1893, his condition was alarming. He was suffering from a most excruciating headache, confined to the right side of the head. The pain was so great that he could not endure it in silence, and he was at times restrained with difficulty from escaping to the street. His convulsions were frequent, as many as one and two occurring each hour. His appetite was gone, and sleep was impossible, except when produced by heroic doses of morphine. His hallucinations were fear of impending evil, loss of family, loss of fortune and reputation.

Medicaments having proved of no avail, the patient was placed in the Allegheny Hospital, and on September 5, 1893, assisted by Drs. Dickson and Myers, I removed a button one and one-half inches in diameter from the right parietal bone, over the juncture of the upper and middle thirds of the fissure of Rolando. By means of the rongeur forceps this opening was enlarged above and below. There was a very perceptible bulging of the dura into the opening, and the

membrane was unusually adherent to the bone. Other than this there was no indication of injury or disease of the membrane. The dura was opened by a crucial incision, whereupon there followed the escape of some two drachms of thin pus, apparently the contents of a degenerated cyst, although there were no remains of a cyst wall. The cavity was washed out with a weak solution of mercuric chlorid, the wound dressed antiseptically, and the patient put to bed. The immediate result of the operation was better than we had anticipated. The headache was relieved, the convulsions ceased, and the mind was restored to its former integrity. These conditions continued and convalescence was uninterrupted until September 16, when there was a sudden return of all previous symptoms. I opened the scalp wound, which had healed by first intention, and found a reaccumulation of pus. After removing all pyogenic substance and washing out the cavity, I introduced a double drainage-tube, and dressed the wound as before. A favorable condition was at once apparent. For a week the wound was washed out with a solution of warm mercuric chlorid through the double drainage-tube. A hernia cerebri was feared, but fortunately the wound closed without any untoward event.

In six weeks from the time of operation, the patient was removed to his home, practically a well man, with the exception of the paralysis. Shortly after this he noticed a return of power in his left leg and arm. This improvement was slow, but continuous, and now, almost two years from the date of operation, he has perfect use of his left leg, and power in the left arm,

in which the paralysis was complete, is restored, with the exception of the deltoid muscle and extensors of the hand, these being yet slightly impaired. He has since filled a clerical position with a traction company.

In the succeeding case, too superficially reported by Lanphear, there are a number of remarkable and almost questionable occurrences. It is really too early to speak of this man as cured.

LANPHEAR, EMORY. (Jour. Am. Med. Assn., June 1, 1895.) *Traumatic insanity; trephining after three years; complete recovery.*

P. G. was a man 52 years of age at the time of operation. Some four years before he came under my care he was kicked upon the forehead by a mule. There resulted a marked depressed fracture of the frontal bone in the median line, just at the margin of the hair. He happened to fall at the time into the hands of a "conservative" surgeon who believed that a depressed fracture should not be operated upon unless profound symptoms of pressure are present, and so the patient was not trephined, because he was unconscious but a few minutes after the injury, and soon went about his business as though his hurt was of no consequence. Had a progressive modern surgeon been called, one who believed that every depressed fracture of the skull should be subjected to operation at the time of injury, however slight the depression and irrespective of pressure symptoms, the most disastrous consequences might have been averted; for very soon a most remarkable change occurred in the

patient. Before the accident he was an exemplary husband, a devoted father, a strong opponent of intoxicating liquors; a man noted for his integrity. Soon after the injury he deserted his wife and sought the company of prostitutes; when at home he was so abusive to his children that they fled from him in terror; he became so addicted to the use of whiskey that his property was soon wasted and he sunk to the level of the sot. He was obscene, vulgar, and debased.

This condition continued for a period of more than three years, with occasional intervals in which it was thought he was going to reform. Finally, after a long debauch, suicidal and homicidal impulses became predominant, and at last the relatives consented to an operation. Upon removing the depressed bone, a large fragment of the vitreous plate was found projecting through the dura an inch or more into the frontal lobes. The superior longitudinal sinus was crushed and filled with an organized blood clot, and much of the middle frontal convolutions showed signs of pressure, but no decided degeneration. There was a little shock and no meningitis following this extensive operation. A marked quietness instead of constant restlessness was the first change noticed in the mental condition; the countenance became more serene, the voice less coarse. As convalescence progressed it was found that the patient was more like his former self; he greeted his wife and children with a pleasant smile instead of with scowls and curses. So soon as bodily health was completely restored he became his old self once more; gentle, affectionate, and trustworthy.

Since the operation there has been no relapse, and his mental condition is as good as before the accident.

Drs. Jacob Frank and Archibald Church reported (Am. Jour. Med. Sciences, July, 1890) a case of insanity much improved by operation. The young woman had been four years in the Elgin Hospital for the Insane. Her father insisted that the insanity was due to an old trauma. Casts of the skull were made and the subject studied very exhaustively. The girl was intellectually so far gone that she neglected all habits of decency, and was taciturn and sullen. Dr. Frank operated and found an unusual amount of arachnoid fluid. The girl made a most remarkable improvement. She recalled her early education, and for three years was able to assist in teaching her younger sisters mathematics. She read for herself and the family. At last she grew morose and depressed, and a second operation was performed. She recovered again, and was somewhat improved, but has since grown worse, and is now in confinement in the asylum.

Paul Schuster (Psychische Störungen bei Hirntumoren, 1902, p. 352) considers 27 cases of insanity operated on for tumor of the brain. Of these tumors 9 were in the frontal region, 15 were in the motor areas, 1 was in the cerebellum, and 2 were multiple tumors. The psychical conditions were as follows: In 17 cases there was loss of intellect or paralysis; in 4 there was mania, irritability, or excitability; 2 were in a state of depression; in 1 case there was puerperal mania, and in 1 paranoia. In only 6 of these cases was the

psychical condition after the operation unreported. All the other cases were either completely cured of the insanity, or they were greatly improved.

HEADACHE AND CEREBRO-SPINAL MENINGITIS

As early as 1660 Marchette advised trephining for uncontrollable headache, and since that time this procedure has occasionally been resorted to. Horsley recommended it in 1890, and it has proved successful in a few cases in which the operation was attempted for the removal of suspected tumors, which were, however, not found. von Bergmann regards the procedure with doubt and suspicion.

In one case of cerebro-spinal meningitis, which had resisted all efforts at relief or cure, I trephined and drained the posterior and middle fossæ of the skull, upon suspicion that the origin of the disease was in the petrosa. The unfortunate termination of the case does not deter me from reporting it. The findings were very instructive, and the case was fought out under the most trying circumstances. Perhaps the use of the defibrinated blood of the convalescent pneumonia patient was unwarranted, but my belief in the ultimate treatment of the self-limited infectious diseases by some such method led me to this experiment.

On Monday, February 26, 1889, I was called in consultation by Dr. Julius Otto, to see a girl fifteen years old, who had been suffering a complexus of symptoms resembling very closely the symptoms of relapsing fever. The sickness was initiated by a chill of great severity, followed by a high temperature and

severe headache, and pain extending down the back and legs. The pulse was not so rapid as would ordinarily be expected with such a temperature. The fever varied from 104° to 105° F. for a matter of nine days, when there was a complete remission. The headache ceased, the temperature and pulse became normal, and the patient slept well and had a good appetite. This intermission lasted about a week, when a second but briefer spell came on with a second chill. The temperature rose to 104, the pain in the head, the distress, and the high pyrexia returned. The pulse was again a little lower than we could naturally expect. This attack endured seven days, when there was again a complete remission, the temperature subsiding to normal, with a cessation of all other symptoms as before. The third relapse occurred at the end of another week, with a chill and high temperature, which lasted only two days, and was followed by an intermission of four days. A fourth relapse followed.

It was during the second day of this relapse that I first observed the patient. Her temperature was at this time 104, and her pulse 96. The face and body showed some emaciation, the pupils were dilated, and she was vomiting at short intervals. The respirations were slightly accelerated. The little girl begged for relief, clasped her head in her hands, and complained of the slightest touch upon any part of the body. This hyperesthesia seemed to me most accentuated over the left side of the head behind the ear. When undisturbed she lay curled up, upon her right side. The tongue was not noticeably coated, but the lips were

chapped and about the nostrils there was some evidence of sordes. The result of examination of the heart, lungs, abdomen, and extremities was negative, except that during the first and second paroxysms of fever there was a noticeable enlargement and tenderness of the spleen and liver. Careful search was made for an area of possible pneumonia, and the heart was examined for evidence of endocarditis, the abdomen and pelvis for suppurative foci, and the joints for infection. There was no tremor of the hands, and no evidence of impairment of motion or sensation, except the hyperesthesia mentioned. The hearing seemed to be equal in both ears, and the sight perfect in both eyes. There was no perversion of taste, and the only abnormal sensations were the general hyperesthesia, and the severe headache which was referred indefinitely to every part of the head.

The diagnosis seemed to rest between relapsing fever, malaria, typhoid fever, meningitis from middle-ear disease, and meningitis from some other form of infection.

With the assistance of Dr. Hall, the blood was examined and malaria and relapsing fever both excluded. The blood count showed a slight leucocytosis; otherwise nothing abnormal. So soon as this result was established a needle was introduced into the vertebral canal at the junction of the third and fourth lumbar vertebræ, and the cerebro-spinal fluid was allowed to run off drop by drop. Two agar tubes and two blood-serum plates were inoculated from this serum, and in twenty-four hours each had shown a pure culture of a diplococcus, apparently the diplo-

coccus of pneumonia. By this means the pathologic character of the disease was definitely determined. We had to do with a case of pneumococcus infection of the cerebro-spinal lymph spaces.

At this juncture we determined upon an experiment. For a small fee we secured three ounces of blood from a healthy German man, twenty-one years old, who was but a week past the crisis of a true pneumococcus pneumonia. The blood was received from the median vein, with all antiseptic precautions, in a sterilized flask, which was at once put on ice and its contents encouraged to coagulate rapidly by the addition of a few drops of calcium chlorid solution, and applications of interrupted heat and cold.

In twelve hours a sufficient amount of serum was at hand, and its injection hypodermically was begun; at first sixty drops, and at each subsequent injection, following at intervals of six hours, a double quantity. The effect of the injections seemed to be noticeable after a short time in a lowering of the temperature and a general improvement. This condition obtained for a period of three days, when all symptoms became intensified. There were repeated chills and high temperature, tremor of the extremities, and an apparent paralysis, or inability to co-ordinate the motions of the right leg and arm. The right side of the face seemed lacking in expression. The patient continued to lie on the left side of the head, but with a decided inclination of the body to the right. The pupils were equally dilated, although no drug capable of producing such result had been administered. When this stupor had lasted twenty-four hours, with gradual aggrava-

tion of the symptoms, there appeared an edematous condition of the skin over the left mastoid. This was the first incontrovertible localizing sign, and I determined to act on the assumption that the disease was due to a primary pneumococcus infection of the ear, with resulting pneumococcus meningitis and probably sinus thrombosis.

The patient's head was, therefore, shaved and prepared for operation. After shaving the edema of the scalp over the mastoid was much more evident, and a lymph gland as large as a bean was felt. The operation was begun with more confidence. The mastoid cells were found to be edematous, and cultures were made from their contents. The skull above the root of the petrous portion was opened and the dura incised. A small amount of serum followed the incision, and cultures were made from this serum. The sigmoid sinus was exposed, but it could not be determined by palpation whether or not it was the seat of a thrombus. A small incision was therefore made in the sinus, from which venous blood flowed readily. The hemorrhage was stopped by tamponade, and the head dressed in the ordinary fashion. The operation produced little or no effect on the course of the disease, and the child died some twelve hours later.

Within eighteen hours a postmortem was held. On removing the dressing there was evidence of but little oozing. The skullcap came off easily, leaving the dura behind with no adhesions. On opening the dura the interlobular spaces were found filled with a cloudy, fibrinous exudate, and the pia was everywhere moderately injected. There was evidence of a slight amount

of pachymeningitis along the middle portion of the longitudinal sinus on both sides. There was no evidence of meningitis at the base of the cerebrum. The base of the pons and the medulla were covered with a firm, yellowish, pus-like exudate, which extended over two-thirds of the right hemisphere of the cerebellum, and over one-third of the left. Cultures were made from the exudate and the adhesions near the longitudinal sinus, which later gave growths of the pneumococcus. The dura was stripped off from the base of the skull with no adhesions whatever on the left side. The left sigmoid sinus and the lateral sinuses were free from thrombi. The right sigmoid sinus was occupied by a white thrombus. The dura was adherent to the posterior side of the petrous portion of the temporal bone, and a superficial examination led me to think that the petrosa was the seat of infection, but a more careful examination established the fact of its health and integrity.

CHAPTER XIII

EMPYEMA OF THE ACCESSORY SINUSES OF THE NOSE

Definition; location and function of sinuses; frequency of disease; complications. The antrum of Highmore: anatomy; disease; symptoms; diagnosis; treatment; illustrative cases. The frontal nasal sinuses: anatomy; disease; symptoms; diagnosis; course; treatment; cases. The sphenoidal sinuses: anatomy; disease; etiology; symptoms; diagnosis; treatment. The ethmoidal sinuses: disease; diagnosis; treatment.

In the broadest sense the antrum of Highmore, the frontal, ethmoidal, and sphenoidal sinuses, the middle-ear and adjoining mastoid and squamosal sinuses, are all accessory sinuses of the nose. Because of the great clinical importance of middle-ear disease and affections of the mastoid, this group of sinuses is considered by itself. There is, however, nothing essentially different in the etiology, course, termination, or indications for treatment of diseases of the sinuses connected with the ear and of those connected directly with the nose.

These sinuses have uncertain functions. They give quality and resonance to the voice; their health and disease are intimately connected with the condition of the nervous system, and especially with the respiratory nervous mechanism and with sensation within the

head. Disease of these sinuses is closely associated with neuralgia, bronchitis, hay fever, some forms of gastritis, and various psychic manifestations.

The fact that the relation between these complaints and disease of the sinuses cannot be explained does not disprove their interdependence. Outside the office of the rhinologist, and frequently even under such favorable circumstances, sinus infection passes unnoticed.

Disease of the accessory sinuses is very frequent. We have already mentioned the fact that almost twenty per cent of children in the higher grades of the grammar schools suffer from some form of middle-ear disease. There are no statistics at hand showing the frequency of disease in the directly connected nasal sinuses. We know, however, that empyema of the maxillary sinuses is most commonly recognized, and that this is probably due to the fact that the symptoms and physical signs are characteristic and easily elicited, while the diagnosis of disease of the other nasal sinuses present the greatest possible difficulties. They are, perhaps on this account, looked upon as being very rare.

All the complications which follow mastoid disease follow likewise disease of the accessory sinuses of the nose, namely: meningitis, sinus thrombosis, extradural abscess, and abscess of the brain. Denker (Archiv. für Laryngologie, Bd. 10) operated successfully for an abscess of the frontal lobe, an extradural abscess, and an empyema of the frontal sinus from which they sprang, and the patient made a good recovery.

The antrum of Highmore is a large pyramidal air chamber occupying the body of the superior maxillary bone. Its base is represented by the nasal or internal surface of the bone, and its apex corresponds to the malar process. It has four walls: the superior, formed by the orbital plate; the inferior, formed by the alveolar process; the anterior, corresponding to the facial surface of the maxilla; and the posterior, formed by the zygomatic surface of the bone.

The base, or nasal surface, must be considered in detail. The nasal bony wall of the superior maxilla is perforated by a large opening divided horizontally by the inferior turbinated bone, above which is the middle meatus, and below the inferior meatus of the nasal cavity. The opening into the middle meatus is made smaller by the palate bone posteriorly, and divided vertically by the uncinate process of the ethmoid, thereby leaving two bony foramina between the nasal cavity and the antrum. Below the inferior turbinated bone the bony partition is made complete by the superior maxillary and the palate bones, and the maxillary processes of the inferior turbinated bones. This partition is generally very thin, and can readily be broken with a strong knife. A groove on the inner surface of the superior maxillary bone is made into a canal by apposition of the lacrymal and inferior turbinated bones so as to form the lacrymal duct, the bony opening of which is high up anteriorly under the inferior turbinated bone. When the soft parts are added it opens a little lower, but is well protected from injury. In the articulated skull the antrum communicates with the middle meatus of the nasal fossa,

generally by two small apertures left between the ethmoid, inferior turbinated, and palate bones. During life only one small opening exists, near the upper part of the cavity, sufficiently large to admit the end of a medium sized probe, the other being closed by the lining membrane of the sinus.

The cavity of the antrum varies considerably in size and shape. In the young it is small and the walls are thick; as life advances the antrum enlarges at the expense of its walls, and these in old age are of extreme tenuity. Occasionally the cavity extends into the malar bone. A mucous membrane with ciliated columnar epithelium lines the entire cavity, except at the ostium maxillare where it is continuous with the nasal mucous membrane; it frequently forms folds and pockets. Compared with that of the nose it is much thinner, is provided with fewer glands, and is therefore much less able to absorb products of inflammation retained within the cavity. The periosteum separates this thin lining membrane from the bone. The blood supply is derived from the spheno-palatine artery and numerous anastomosing branches on all sides of the antrum, but all these arteries are of small diameter, permitting an easy control of hemorrhage by gauze packing. Along the orbital surface is the infraorbital nerve. On account of this nerve, the thinness of the plate of bone, and proximity of the orbit, this surface must be curetted with the greatest care. Crossing the cavity of the antrum are often seen several projecting laminæ of bone, similar to those seen in the sinuses of the cranium; and on its posterior wall are the posterior dental canals, trans-

mitting the posterior dental vessels and nerves to the teeth. Projecting into the floor are several conical processes, corresponding to the roots of the first and second molar teeth; in some cases the floor is perforated by the teeth in this situation.

The ostium maxillare opens into the hiatus semilunaris, through which the frontal sinus drains by way of the infundibulum. Occasionally the frontal sinus and antrum of Highmore communicate through the infundibulum, so that fluids may gravitate from one sinus into the other.

Inflammation of the mucous membrane of the antrum usually originates through a direct extension of an infection in the root canal of the canine or one of the molar teeth, in which case it is suppurative from the first; or it may arise by extension from the mucous membrane of the nose or adjoining sinuses, in which case it may be of the so-called catarrhal nature. In the beginning the inflammation involves the mucous layer alone, causing edema, desquamation of the epithelium, and the production of ulcers. Secondary extension carries the inflammation to the submucous tissue and to the periosteum itself. The bone-forming properties of the periosteum are often excited, producing a deposit of spongy masses or spiculæ of bone, reaching out into the antrum. The mucous and glandular structures of the antrum are greatly hypertrophied, resulting in polypoid masses that choke the exit from the antrum and completely fill the cavity. When the inflammation is of a less acute nature, with the primary focus of infection in the floor of the antrum at the root of the cuspid, or canine tooth, the

antrum becomes partially filled with pus, which leaks out at intervals into the nose, and is swallowed at night, or blown out during the day, with few or no local symptoms. There is little or no tendency to spontaneous cure, and great tendency to seasons of exacerbation. The disease continues for years with few symptoms which would attract the attention to its character or location.

The disease is incident to all ages, but most common in middle life. In one case a child eight weeks old had an abscess of the antrum, the result of trauma received during instrumental delivery.

The symptoms are quite variable. Bromner, in the London Lancet, 1897, Vol. 2, page 144, reports three cases in which a bad smell in the nose was the only symptom complained of. In cases in which the cavity remains closed the symptoms presented are a sense of weight, depression, and pain in the region of the superior maxilla; throbbing; fever, if the absorption of toxines is taking place; swelling and redness of the cheek; if retention is great, protrusion of the eye on the affected side is noticed; pain, following pressure on the second division of the fifth nerve; in case the distention has been so great as to produce a thinning of the walls of the antrum, crepitation may be noticeable on pressure, this being regarded as a classic symptom by Dennis; and last, there may be a sudden discharge of pus into the nose, or through the socket of a tooth into the mouth. When the ostium maxillare remains patent, there is either a continuous or intermittent discharge into the nose. This discharge may be increased by turning the head of the patient

towards the unaffected side. There is usually some odor to the discharge, which odor is perceived only by the patient, differing in this respect from ozena.

The diagnosis is not always easy. Pus issuing from the nose should lead us to suspect empyema of one of the accessory nasal cavities—the antrum, the frontal, ethmoidal, or sphenoidal sinuses. Transillumination of the face by means of a small electric light held within the mouth, the lips being closed and the room being absolutely dark, may be a valuable aid to the diagnosis of empyema of the antrum. If the two sides of the face are equally illuminated, especially in the region of the lower eyelid, and a reddish light is seen in both pupils, by both examiner and patient, it is a very good evidence that there is no pus in the antrum. If, however, the upper eyelid, malar region, and pupil of one side are brilliantly illuminated while the corresponding regions of the other side are much dimmer or not illuminated at all then we may be positive that there is some condition on that side of the face to account for the obstruction of the rays of light. This obstruction may be due to a naturally abnormal and thickened bony wall of the antrum, to pus, or to the presence of a bony or fibrous tumor situated in the cavity. Only by opening the antrum can it be decided which of these conditions is present.

The treatment of empyema of the antrum is strictly surgical. The offending tooth should be removed, and the opening thus made into the antrum should be enlarged so that the little finger may explore the whole cavity and remove any necrotic bone or granu-

lation tissue present. Care should be taken to re-establish the ostium maxillare, and even to enlarge it. In considering the possibility of a cure, we know that this will depend upon leaving enough mucous membrane inside the antrum to cover it again. Therefore, the sharp spoon or curette should not be used so vigorously as to remove all the mucous membrane and leave the bone or periosteum bare. After the curettement the cavity should be packed with strips of antiseptic gauze, and at the second or third dressing a wax cast of the opening which has been made should be taken, and a silver or hard-rubber canula fitted into the opening to connect the antrum with the mouth. This canula should be worn until the cavity has assumed its normal condition, which ordinarily occurs in from three to four weeks. Frequent daily irrigation should be practiced during this period.

There are cases of empyema of the antrum in which all the mucous membrane of the antrum has been destroyed, and therefore all hope of restoring the cavity to its normal condition is lost. This condition may sometimes be recognized at the operation, and sometimes only after one or two efforts to close the antrum by the method described above. Under such circumstances the only hope of cure lies in the removal of the front or anterior wall of the antrum, allowing the soft tissues of the face to fall in and completely obliterate the cavity. This is a last resort, and for cosmetic reasons it is desirable to avoid it.

The following case illustrates a common, but faulty method of operating. The restoration of the normal opening from the antrum was neglected, and its spon-

taneous re-establishment was erroneously attributed to a particular solution which probably had nothing to do with the case one way or another. Because of this unfavorable comment, the case is abstracted anonymously.

C. G., aged 38 years, had suffered with intermittent pain and swelling in the right maxillary antrum for six years. The second bicuspid tooth had been extracted and communication with the antrum thus effected, but after five years' treatment, during which time the patient wore a canula, there was no improvement in his condition. He complained of asthma and trifacial neuralgia, both of which distressed him at times to an extreme degree. In June of 1901, under chloroform anesthesia, Dr. Whippern opened the antrum by way of the canine fossa, and after curretting the cavity, packed it with iodoform gauze. At that time the mucous membrane lining the sinus was but moderately thickened, and it was concluded that the disease was probably secondary to nasal trouble.

For a month the cavity was irrigated with solutions of boric acid, hydrozone, and potassium permanganate with little benefit, and although the attacks of asthma and neuralgia were not so severe, paroxysms frequently occurred. It was impossible to force the irrigating solutions through the ostium maxillare into the nasal cavity, whereupon a bulb syringe was employed by which more force could be applied, but even under great pressure, with ordinary solutions, the ostium was found to be impervious. A solution of silver nitrate, 0.25 per cent, was then injected three times weekly, for a period of three weeks, with some

improvement in the symptoms, although the ostium remained closed. At this stage of the case nargol, in 0.25 per cent solution in one quart of water, was injected three times weekly. After the first pint had been used, the fluid was observed dripping from the nostril. From that time there was no difficulty in forcing the solution through the antrum, and soon after the neuralgia and asthma disappeared. The patient was discharged cured after three months' treatment. During the succeeding winter he was free from neuralgia and asthma, despite several colds and an attack of influenza.

Incompetent dentistry; acute empyema of the antrum; immediate opening of the ostium, and removal of the atrium of infection; complete recovery.

Mr. S., a stenographer, had never suffered of any disease of the nose or throat; he had a good voice and a well-formed face. He went to a "dental parlor" to have some cheap dental work done, and the left canine tooth was treated and filled. Pain, however, continued in the side of the jaw, and for more than a year there was a swelling of the gum and a highly offensive discharge from the left side of the nose. He began to suffer with sore throat early in the fall, and had frequent attacks of tonsilitis. Early in January, and after exposure to cold winds in walking to his place of business, he was taken with a terrible chill and very severe pain in his head, especially over the left side, extending from the occiput to the chin. There was an early delirium, and in the middle of the night I was first called to see him. I made a diag-

nosis of empyema of the antrum, based upon the excessive tenderness of the left side of the roof of the mouth, the painful condition of the left cuspid, and the opacity of the left side of the face when viewed under transillumination. The patient was given a hot enema and bath, and a large dose of magnesium sulphate, preparatory to a surgical operation next day. A few doses of phenacetine served to reduce the pain somewhat and to lower the temperature.

On the following morning he was anesthetized with chloroform and the antrum was opened through the canine fossa. The pus contained was washed out and the cavity thoroughly explored with the little finger. It proved to be smooth, and the floor of the cavity showed no evidence of dead bone. The ostium maxillare was opened with a cleft-palate knife, and drainage secured by packing the cavity with a wick of iodoform gauze. A cast of this opening was made a few days later, and a hard-rubber drainage-tube was fitted for me by a dentist. The tube was slightly enlarged at its antral end in order to render it self-retaining. The patient left the hospital at the end of a week, and continued wearing the drainage-tube for a little more than a month. The opening rapidly shrank after removal of the tube, and a year and a half later it was completely closed, with no return of the disease.

This was an uncomplicated case of disease of the antrum, and the chronic suppuration had been going on for a long time, as is indicated by the history. The primary source of the infection was the remnant of infected pulp at the root of the canine tooth. Suppuration extending from this gradually destroyed the

overlying bone and mucous membrane, the pyogenic germs finding a rich culture medium in the occasional hypersecretion of the mucous membrane of the antrum. When through exposure to cold the vascularity and distension of this modified membrane closed the ostium maxillare, the pus was confined within the antrum, and immediately gave rise to the symptoms of an unopened abscess.

Chronic empyema of the antrum springing from the nasal cavity; continuing two years; drainage; improvement.

Mrs. D., 42 years old, was the mother of a family of healthy children. While traveling in Europe the children became ill of diphtheria, and the mother cared for them during this illness in a hospital in Milan, and later, incident to another illness, in a hospital in Paris. Although she was herself during this time the recipient of most intelligent care, the history of her condition would indicate that she suffered of a mild form of diphtheria.

Two years later, after she had returned to Chicago, she became pregnant, and was troubled up to the seventh month with morning sickness, and usually one or two spells of vomiting before breakfast. The vomited matter was a thick, stringy, purulent fluid, which attracted no special attention from the patient.

When I first saw her I was struck by the nasal sound of her voice, and the moist and sallow condition of her skin. Her temperature was slightly above normal; she had vomited that morning, and after an interval of two hours, had eaten a light breakfast, and

now, about noon, was feeling pretty well and ready for lunch.

During the examination, which was made to determine the position of the fetus, and the term of pregnancy, she was obliged to empty the left nasal cavity several times. The material which was blown from the left nostril was decidedly purulent, and almost odorless. Turning my attention to the oral and nasal cavities, I found that the roof of the mouth and the wall of the antrum were not tender. The canine and premolar teeth were alive and painless. The left nostril, after careful cleansing with moist pledgets of cotton, became quickly filled with a secretion which was proved by subsequent microscopic examination to be purulent. No apparatus was at hand for transillumination, but a burning match in the mouth clearly indicated to the patient the suspected obstruction of the antrum. The crude but not ineffective method by which this condition was demonstrated is as follows: The patient was placed in a dark room, with her back to the door, and requested to light a match, and after the flame was burning steadily, to hold it between the teeth with lips and eyes closed, until it went out. She was particularly requested to note if she saw a red light equally brilliant in both eyes. She declared that the left eye seemed dark, while in the right there appeared a bright red glow.

On the following evening the electric illuminating apparatus was used, and the opacity of the left antrum positively demonstrated. In inquiring more particularly into the history, there was no evidence that the antrum had ever been completely closed, and

there was no history of any acute disease of the cavity.

In spite of the fact that she was almost at the period of confinement, and even because of this circumstance, an operation was recommended which would relieve her of the constant discharge of pus, the vomiting, the slight rise of temperature, the low septic condition, and the danger of puerperal infection or disease of the kidneys. She was accordingly anesthetized with chloroform, by Dr. D. H. Galloway, and an incision was made into the antrum just above the roots of the teeth, and in the line of the canine fossa. This perforation was sufficiently enlarged to permit of exploration of the cavity by the index-finger. The antrum was completely filled with a hard, polypoid mass, containing pus and detritus. This mass was carefully removed with a sharp spoon, and the entire cavity packed with iodoform gauze. In the course of the next two days a small tube was fitted into the opening, and through this the antrum was washed out several times a day with antiseptics. Under this treatment the vomiting ceased, the appetite returned, the sallow and clammy condition of the skin disappeared, and the patient went on to her confinement without further complication or difficulty.

The tube was removed several months after its introduction, and the cavity found to be nearly filled with a fresh growth of the polypi. The case was turned over to Dr. T. M. Hardie, who treated it successfully in his office. During the past four years this patient has had a normally resonant voice, and no evidence of disease in the antrum.

In some cases the wall of the antrum is destroyed. Great flakes of bone become necrotic, and keep up the suppuration even after good drainage has been established. Such cases never come to an end. It then becomes necessary to raise the cheek, excise the anterior wall of the antrum and remove such masses of necrotic bone as present themselves. Every case of this kind stands for bad practice, unwarranted neglect, or absence of medical advice.

MAXIMS

1. Neuralgia, catarrh, bronchitis, and asthma are symptoms of antral empyema.
2. Empyema of the antrum often springs from a *dead* canine tooth.
3. In acute empyema the ostium maxillare is closed.
4. Acute empyema demands immediate drainage, and the restoration of the ostium.
5. In chronic empyema the ostium may remain patent.
6. In chronic empyema, removal of the offending tooth may suffice.
7. Necrosis of the antral wall stands for neglect of an acute empyema.

THE FRONTAL SINUSES

The frontal nasal sinuses occupy the bone of the skull between the roof of the orbit, the superciliary ridge, and the base of the skull. They develop in extent as age advances, and show great variability and irregularity in different individuals. They regularly consist of two cavities, each communicating with the

corresponding side of the nose, and separated from each other by a thin, bony septum located somewhat in the middle line, and under the crista galli. The sinuses are usually larger in men than in women, and are often asymmetrically arranged. Although a single cavity is the typical form, this is frequently divided more or less completely into compartments by bony

84. Section through the frontal sinuses and nose, showing two series of sinuses on the right, and one with infundibulum on the left.

partitions extending from the roof of the orbit to the base of the skull. In quite a large number of cases there are two or more sinuses on each side, one behind the other, communicating by separate infundibula with the nose. These openings are in close proximity to the openings of the antra of Highmore, and the openings from the ethmoid cells.

Inflammation of these sinuses appears both as a chronic and an acute condition. It is apparently a little less common than empyema of the antrum of Highmore. It begins as an influenza, or as an inflam-

mation of the upper nasal cavity due to polypi or to infection of the ethmoidal, sphenoidal, or maxillary sinuses. In its acute form it is a most sudden and serious disease. In its chronic form it goes on from year to year, giving rise to indefinite and non-localizing symptoms. In this latter case the patient has a bad taste in the mouth, especially on rising in the morning, and is frequently nauseated to the extent of vomiting. Some patients complain simply of indigestion and loss of appetite, especially during the fore part of the day. In other instances the swallowing of the constantly extruded pus gives rise to no symptoms at all.

For whatever cause the patient consults a physician, it will probably be noticed, by the sound of the voice, that one of the nostrils is obstructed, and that the voice lacks that resonance which the open sinuses impart. In a few cases there is a distinct and well-recognized frontal headache, and the patient will sometimes notice that this headache disappears with a profuse and continuous discharge from the nose. In other cases the patient complains of pain in the eyeball. This is sometimes a constant ache and sometimes a shooting pain. The symptoms are all so intermittent in character that they are frequently diagnosed as malarial, and often enough get some relief from the quinine treatment. The effect upon accommodation is such that the use of glasses gives relief, and the occulist is given credit for a cure. Sometimes the patient complains of laryngitis, or bronchitis, and the vocal apparatus is found inflamed, probably by extension of the infection from the constantly dis-

charging pus. In other cases the symptoms complained of are cerebral. The patient has sudden fits of dizziness, or loss of consciousness for a moment or two, or even suffers from fainting spells.

The examination of the patient too often throws but little light on his condition. Tapping over the sinus, or pressing upon the roof of the orbit, sometimes give rise to distinct pain which can be differentiated from the normal by the lack of these symptoms on the opposite side. Transillumination of the frontal sinus sometimes gives positive indications, but in other cases the orbital arches seem equally transparent. This is not to be wondered at when we consider the frequency with which the frontal sinus is composed of two or more separate systems. Examination by way of the nose is in these cases often difficult and only rarely can the pus be recognized as coming down on one side of the septum. Even in these exceptional cases it is uncertain whether the discharge comes from a frontal or ethmoidal sinus until a turbinated bone has been removed.

It is fortunate that the diagnosis of the acute disease, with obstruction of the outlet of the sinus, is more easy. In the acute disease the onset is announced by a protracted chill. The temperature rises at once, with excruciating pain in the head (hemicrania). The pain is localized in the eyeball and photophobia is usually intense on that side of the head. After a longer time the pain is felt in both eyeballs, and in the distribution of the whole fifth nerve. The temperature is a distinctly septic temperature, and often of a very high grade. This feature depends, of

course, upon the character of the infection, and the relative completeness of the obstruction.

While the course of the chronic disease is protracted and devoid of incident, except the malaise and diminished vitality of the patient, the course of the acute disease is most rapid, painful, and disastrous. In a few hours, or days at most, the mucous membrane and the bony wall of the sinus give way, and an opening results either into the cranial cavity above, producing an extradural abscess, into the orbit below, or into an adjoining frontal sinus. As the process goes on the symptoms may become those of a cerebral compression, a retrobulbar abscess, or of necrosis of the frontal bone.

An interesting case of frontal sinus disease fell under my observation which illustrates two of the conditions described: In conversing incidentally with a boy eight or nine years of age, I noticed the imperfect character of his voice, and advised him to consult a rhinologist for obstruction of the left nasal passage. He consulted Dr. T. M. Hardie, who removed some polypi from the passage, and treated the nose for a short time. The voice, however, did not improve, and the boy neglected treatment. After a hard run one day some three years later, he had a severe chill and a terrible pain, which was scattered over the left orbit and its contents. The temperature rose to 105° F. The boy became delirious, and after forty-eight hours of symptomatic treatment the pain was so much localized in the globe of the eye that an ophthalmologist was called. When first seen by Dr. Frank Allport, the left eye protruded from the orbit downward, the lids

and the scalp were edematous, and the veins of the temple were engorged. The pulse, temperature, and general condition of the patient were those of pronounced intoxication. The boy was removed at once to St. Luke's Hospital, and the retrobulbar abscess was opened just under the arch of the orbit. In the course of the next week I saw the patient in consultation. His temperature was then considerably reduced, the orbit was draining freely, and Dr. Allport had recognized the necrosis of a considerable portion of the arch of the orbit. The patient reminded me of my previous diagnosis and advice, and I suggested the obliteration of the frontal sinus as a proper treatment.

On the following day the frontal sinus was opened by Dr. Allport, and a passage secured into the nose. The superior turbinated bone was resected, and all necrotic bone in the region of the sinus was cut away. The inflammation subsided promptly, but the sinus continued to discharge a little pus for several months. The displacement of the globe of the eye had been so great that complete blindness in this eye followed, although the normal appearance of the eye returned.

After two years there is little or no disfigurement, and there has been no return of the disease.

In this case there was, during the first forty-eight hours, abundant time to open the frontal sinus, drain it, and secure a prompt recovery, providing a proper diagnosis had been made. The fact that the nose had been unsuccessfully treated, and that the onset was so sudden and attended by such localizing pain in the globe and region of the orbit, was sufficient material

for diagnosis. The rarity of the disease is perhaps the only excuse for its neglect or oversight. The terrible results of the progress of the disease are sufficient warning to all practitioners to keep this subject in mind and institute prompt and efficient treatment.

Empyema of frontal sinus with inadequate symptoms; operation, revealing anomalous condition in anatomy involved; drainage instituted; complete recovery.

A. J., a medical student, 24 years of age, of Scandinavian extraction, slight in build, with large features and very prominent superciliary ridges, a vegetarian of abstemious habits, had always had a peculiar nasal voice. In December of 1901, after exposure to cold, he was taken with a severe chill, and his temperature rose to 106. He was delirious during the first two or three hours following the chill, and when the temperature had been slightly reduced by baths, his delirium passed off and he complained of most excruciating pain in the head and the globe of the left eye. The pain settled at last in the region of the left eyebrow and temple. There were two attacks of vomiting; one soon after the chill, and another on the following morning. The vomiting seemed to have no relation to the contents of the stomach. During the succeeding twenty-four hours the pain continued and the temperature never fell below 104. The patient was absolutely sleepless on account of pain. I saw him for the first time on the evening following the chill, and twenty-four hours after the exhibition of the first symptoms. His temperature was then 104, his pulse 110, and he was conscious, but not wholly rational.

The veins over the left temple, leading from the ridge of the orbit, were greatly enlarged. This condition was very noticeable as compared with the veins on the opposite side. Pain was still confined to the globe of the left eye and the region of the left orbit and temple. Tapping over the parietal bones showed greater tenderness on the left than on the right side. Tapping and pressure over the orbital ridge produced great pain over the left orbit, and some pain over the right. Although the globe of the eye was excruciatingly painful, it was not tender. Pressure from side to side upon the bridge of the nose produced pain in the left orbit. The region of the left ethmoid seemed to be excessively tender. Transillumination was not very satisfactory; an electric lamp was used and only a slight difference could be noticed in the transmission through the superciliary ridges. Both antra were apparently empty. The result of examination of the chest, abdomen, and neck, was negative. There were no enlarged lymph glands in front of the ear, in the region of the parotid, or under the angle of the jaw on either side. Both nostrils were open.

In spite of the absence of opacity in the region of the left frontal sinus, I advised operation designed to open it. The patient was removed to a hospital, and anesthetized with chloroform. The eyebrows were shaved off and transillumination was again tried, but with the same negative result. An incision was made under the left eyebrow, reaching from one end of the orbit to the other. A small exploratory opening was made into the frontal sinus about the middle of the ridge, but the sinus was found empty. In spite of this

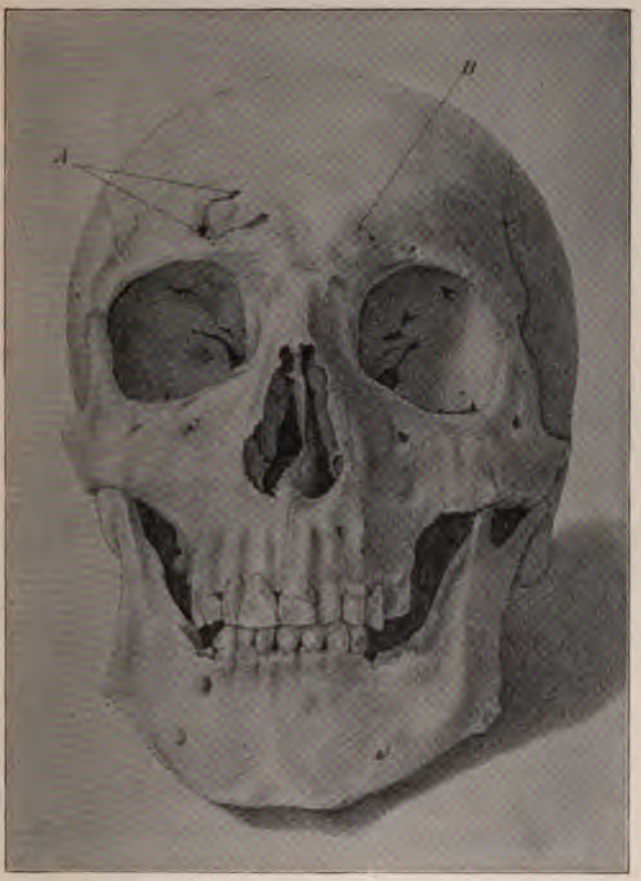


PLATE VIII

Skull of a man, 41 years old, who evidently had a defect of the skull (A) over the right frontal sinus, the result of suppuration within the sinus. On the left (B) is the foramen of a small artery and vein in its natural place. From an article by v. Helly. Langenbeck's Archiv., Bd. 41.

disappointment the supraorbital artery and nerve were cut off in the notch, and the artery ligated.

The sinus was now opened on its orbital side from end to end. It was absolutely empty. With some hesitancy a small opening was made in the superior dorsal wall of the sinus considering the possibility of an extradural abscess in this region. Through this opening at least a drachm of pus poured out. The opening was then carefully enlarged with a chisel, and it was found to communicate with a second frontal sinus reaching beyond the middle line of the nose. The depth of the sinus and the fear that some portion of its bony wall had become ruptured led me to cut away the partition between it and the anterior sinus. The skin flaps were turned into the excavated bone, forming a sort of canal.

On the following day the temperature was normal and remained so during the convalescence. After the first twenty-four hours the patient undertook upon his own advice, the open treatment of the wound, lying in such a position as to allow the direct rays of the sun to fall into the bottom of the wound through a large condensing lens. The discharges from the wound were wiped off with antiseptic sponges. Under this treatment the granulations were very rapid, and the wound closed from the bottom. The canal under the ridge of the orbit became a line, and the left frontal sinus appeared to be completely obliterated. The patient recovered, and after the growth of the eyebrows, there remained no evident deformity.

THE SPHENOIDAL SINUSES

The sphenoidal sinuses are developed in connection with the nasal fossæ by a process of extension and absorption carried on in the body of the sphenoid bone. They are lined by a continuation of the nasal mucous membrane, of a peculiarly thin and fragile character. These sinuses show great variety and irregularity in form and arrangement, as do, in fact, all the accessory sinuses in connection with the nasal cavity. This feature depends on the irregularity of the process of absorption by which they are developed. Finger-like cavities are formed in the body of the sphenoid bone, so that not infrequently many overlying cells are hollowed out. In the frontal sinuses as many as three systems of cells may be found from before backward, separated by bony septa, and all connecting with the nose. The sphenoidal sinuses are cavities of irregular form, usually divided by a median bony partition, which is deflected to the right in about forty per cent, to the left in thirty per cent, and is central in thirty per cent of skulls examined. Anteriorly the sphenoidal septum joins with the bony septum of the nose. The atria leading from the sinuses into the cavity of the nose are, as a rule, two in number, and are situated on the anterior surface of the sphenoid bone, on either side of the median line, and high up under the superior turbinated body. It is possible to pass the index-finger up through the posterior nares and feel the angle formed by the junction of the anterior and inferior surfaces of the sphenoid bone. This angle lies at an average depth of 6 cm. from the

anterior nasal spine. The posterior wall of the sinus lies from 1.5 to 2 cm. farther back. Immediately above the sinus lie the optic chiasm and pituitary body, and laterally lies the internal carotid artery, separated from the sinus by a bony shell almost as thin as tissue paper. Surrounding the artery are the cavernous sinus, the third, fourth, and ophthalmic division of the fifth nerves. The posterior wall of the sinus is of a little greater thickness than the lateral wall.

The sphenoidal sinuses are frequently the seat of an empyema. This follows and is due to an extension of a catarrhal inflammation in the nasal cavity. It may be secondary to influenza, hay-fever, scarletina, and other infectious diseases. It is most common between the ages of twenty and forty.

The diagnosis depends principally upon a careful rhinoscopic examination. Pus is found draining from the superior meatus. An exudate from the sphenoidal sinuses empties into the nasal fossæ behind; hence posterior rhinoscopy will discover the pus streaming over the posterior ends of the cornua. The patient usually exhibits a temperature, and an examination of the blood shows a leucocytosis. A pharyngitis, produced by the discharge draining down the posterior nares, is a common finding. The patient has an almost continuous headache, the pain being dull and deep-seated. The breath is usually fetid.

The bulbus sound may detect a necrosis in the anterior wall of the sinus; great care, however, must be exercised in making this examination. No sharp pointed probes should be used on account of the danger

of penetrating the posterior or lateral walls of the sinus. The middle turbinated bone may be resected, allowing any pus streaming down from the antrum to be seen.

In consideration of the danger of meningitis and intracranial involvement, the sinus should be promptly drained and a permanent opening established. Several

85. Kitterman's method of locating the sphenoidal cells; the finger in the posterior nares serving as a guide in operating.

forms of surgical treatment have been advocated: (1) Intranasal puncture; (2) opening by way of the frontal sinus; (3) resection of the superior maxilla, or approach through the maxillary antrum.

With due consideration of the relative anatomy of the structures surrounding the sphenoidal sinus, intranasal puncture is far too dangerous a procedure to be recommended. After a careful study of the relations of the parts the following operation seems perfectly safe and simple: pass the index-finger up through the posterior nares on that side from which the septum is deflected until the finger tip passes the angle of the sphenoid formed by the floor and anterior wall. With

the other hand pass a small scalpel into the anterior nares of the same side until the tip of the knife is against the angle of the sphenoid, the finger tip in the posterior nares serving as a guide. An incision is made along a line between the vomer and the vertical plate of the ethmoid, three-fourths of an inch forward and downward. Then introduce an eight-inch artery forceps and by opening them, deflect the septum to the opposite side and so uncover the anterior surface of the entire sphenoid. Now introduce the sphenoid bone forceps and remove the anterior wall of the sphenoidal sinus, keeping in the median line, and guiding the forceps with the tip of the finger passed through the posterior nares.

After removing the anterior wall of the sinus, pack a small strip of gauze in the sinus itself and tamponade the nasal cavity to control any unusual hemorrhage. The packing should be removed after about thirty-six hours.

Ultimately the mucous membrane of the sinus will unite with that of the nasal fossa and leave an opening sufficiently large to prevent a recurrence of the disease. This operation was developed for me by Dr. P. Gad Kitterman.

THE ETHMOIDAL SINUSES

Infection of the ethmoidal sinuses is a condition commonly, though incorrectly, regarded as of rare occurrence; usually it is recognized as accompanying infection of the frontal or maxillary sinuses. It is asserted by some authors that this disease never occurs alone, but this is a statement which experience fails to

verify. The difficulties of diagnosis are so great that the disease is rarely recognized except in its most exaggerated forms, or when the anterior sinuses are especially involved. It is sometimes mistaken for empyena of the lachrymal sac when it breaks through into the orbit and produces a superficial abscess at the corner of the eye. The disease can be recognized with certainty in those instances in which the olfactory fissure becomes filled with the exudate of inflammation. The pus gradually drops down into the nose, sometimes in front, producing scabs and scales, and sometimes into the posterior nares and pharynx. The symptoms are indistinct: pressure, headache, and the signs of a mild intoxication are commonly exhibited. In long-continued cases the olfactory nerve is often destroyed, but this points to the focus of infection only about the time of recovery. The extent of the cells and the labyrinthine character of their connection with one another makes any sort of surgical interference very difficult and uncertain.

The rhinologists are accustomed to remove the turbinated bones that stand in the way, and by means of the cautery or the bur open the cells under cocaine anesthesia. Many recoveries under this procedure are reported.

From a surgical standpoint the disease is of interest on account of its association with the more serious disease of the frontal and sphenoidal sinuses. It is very often unexpectedly discovered in the course of operations upon the frontal sinuses. When the indications warrant it, the ethmoidal cells may be approached by Gussenbauer's temporary resection of

the root of the nose. Such a necessity is, however, hard to imagine.

Because of the proximity of the ethmoid to the base of the brain and the large vessels supplying it, suppurative disease in its cells may cause, over and above the common physical manifestations, psychic symptoms of sufficient intensity to suggest paranoia. Surgical interference in these cases is even more urgently indicated than in those uncomplicated by the mental symptoms, and relief of this condition may be expected to occur with the restoration of the patient's physical well-being. Such a case is appended:

In 1895 a man consulted me concerning a sacro-iliac abscess in one of his clerks, and remained in the city while the necessary operation was performed. During this time he related to me the serious family difficulty which had arisen between himself and his wife. She had become strangely and immoderately jealous of him, and objected to his business contact with all women, old or young. She had set herself to spy upon his actions, and would frequently interrupt him while he was engaged in transacting sales, in his open store, with the most unattractive women. With no other symptom of disease than this as a guide, I began to inquire into the wife's medical history. She was a well, hearty woman of 35 years; she menstruated regularly, and until the year of 1893 had never suffered any serious illness. During the fall of this year she had a protracted case of grip, the principal symptoms of which were confined to the head. There persisted after this attack severe headache and a constant dis-

charge from the nose. At times this discharge was offensive and excoriating, and again it would be troublesome only because of the constant dripping into the posterior nares. For a period of two years she had suffered almost daily headaches, coming on during the afternoon and lasting until she had relief in sleep. On a few occasions she had attacks of nausea and vomiting, usually early in the morning or late at night, the latter accompanied by headache. Ever since the attack of grip she had what amounted to illusions of jealousy. The husband assured me that they were absolutely unwarranted, and that she was equally jealous of the most unattractive old women and of little girls scarcely in their teens.

After hearing the history, I advised the propriety of taking the woman to a rhinologist, and suggested the possibility of ethmoidal sinus disease. Three years later I learned that she had been operated on by Dr. E. Fletcher Ingals, that the ethmoid was drained, and that she had recovered from her headaches, her catarrh, and her jealousy.

TUBERCULOSIS OF THE ACCESSORY SINUSES OF THE NOSE

Tuberculosis of the accessory sinuses of the nose, like tuberculous disease of the mastoid, is a rare but not unknown condition. The physical findings are similar to those in tuberculosis in the neighborhood of joints. The mechanism of the infection is similar to that of a pyogenic infection. It is possible that primary localization of the bacilli in the bone is more common than in infections by pus microbes. Frank

and Kunz have reported a case of tuberculosis of the frontal sinus (Med. Rec., November 3, 1894), and collected the literature up to that date.

Tuberculosis of frontal sinus in a man 28 years old; recurrent headache extending over a period of three months; localizing symptoms in region of right eye with displacement of globe; appearance of tumor in region of right lachrymal gland four days later; operation to open frontal sinus; evacuation of pus; recovery.

The patient is 28 years of age, married, 5 feet 8 inches tall, and weighs 160 pounds. He had always been in fairly good health up to a year ago, when he began to lose in weight, had severe headaches, lasting for a day or two, and occurring every week, the intervals being free from any ill feeling. He continued in this way for three months, when he complained of the pressure of his hat across the forehead; he would frequently tilt back his hat and thereby gain relief. Three months later he consulted a physician for some growth on the left side of the forehead, which lasted three weeks. At about the same time the patient noticed a swelling in the region of the right frontal sinus, which caused him incessant pain. Hot fomentations, nasal douches, and anodynes were given with no apparent relief. On the morning of June 16th the patient noticed that his right eye was partially closed, and the upper lid was inflamed and painful. Dr. Frank was then requested to see the patient, and found, in addition to the above-mentioned fact, that the right eye was pushed downward to a slight extent; vision was not impaired. On the outer right side of

the nose there was a faint blush creeping gradually toward the inner canthus, and mingling there with the redness of the upper lid. The patient had a temperature of 100½ F., pulse 96. Kidneys and heart negative; fingers clubbed. About the meatus urinarius, a tuberculous ulcer was found, which healed promptly upon application of europhen. The lungs, on auscultation, revealed vesiculo-bronchial breathing; rhinoscopic examination gave negative results. A mild anodyne was given, and the patient was kept under observation. Four days later he was again examined, and in palpating the upper lid a fluctuating mass was discovered in the region of the lachrymal gland. Temperature was 100 F., pulse 96. Operation was advised, and on June 26th was performed, in the presence of Drs. Verity and Edmunds, with the assistance of Dr. S. Kunz. A curved incision was made, starting about half an inch to the left of the glabella, and extending to a point half an inch posterior to the external angular process, the incision being made down the bone and one-fourth of an inch above the eyebrow. The pericranium was found thickened, the tissues having been pushed back, and the bone over the frontal sinus being roughened. The sinus was opened with a hammer and chisel, and in the sinus there was found a yellowish, cheesy mass, which was removed with a sharp spoon. On the posterior wall of the sinus there was found a focus which had almost gained access to the vault. This focus was removed with the sharp spoon, and a small portion of the dura was all but exposed. At the right lower angle of the sinus a small channel was found, which, upon being

followed out, led the way to the fluctuating mass in the upper lid. The tissues now being pushed over the supraorbital arch, this mass was reached, and proved to be about one drachm of yellow pus, coming from the frontal sinus by means of the small channel, already described, on the inner surface of the frontal bone. The supraorbital arch was found diseased throughout its entire extent; four foci were found which had undergone cheesy degeneration. The entire arch was chiseled away, the soft tissues being thoroughly scraped; the right nasal cavity was also scraped out through the frontal sinus by means of a sharp spoon. The sinus was packed with iodoform gauze, extending into the right nasal cavity, and the wound sewed up with interrupted silk sutures.

The wound was entirely healed on the eighth day, with the exception, of course, of the part immediately above the sinus. The air sinus lasted till the eighteenth day, when it also closed up. The patient felt free from pain from the day of the operation, and his temperature was normal after this first day.

Dr. T. Gramm examined the bone chips from the arch for bacilli, the cheesy masses and foci having accidentally been lost. Although no tubercle bacilli were found, there would seem to be no doubt concerning the diagnosis, from the character of the cheesy masses found in the sinus, from the cheesy foci in the bone, from the yellowish pus found in the cellular tissue of the upper eyelid, and from the history of the patient.

LITERATURE

The literature of this subject must be sought for in the better texts of pathology and rhinology, and the current literature in the annals referred to in previous chapters. The following articles are worthy of consideration, and guide to some of the previous literature:

Bryan. Chronic Empyema of the Frontal, Ethmoidal, and Sphenoidal Sinuses. Am. Jour. of the Med. Sciences, Sept., 1902.

Mosher. Measurements for Operating Distances in the Nose. Annals of Surgery, Oct., 1902.

CHAPTER XIV

THE PAROTID GLAND

Introduction; anatomy; retention cysts; suppuration in the parotid; tuberculosis; mixed tumors.

The parotid gland has a medical and pathological history unique and complete. By the multiplicity of the affections to which it is liable it acquires a peculiar interest for the surgeon. Not only is it the site of one of the common infectious diseases of childhood and adolesence (mumps), but as well of conditions infinitely more grave in consequence and more difficult of treatment. Calculi form in the parotid and in its duct, just as in other secreting glands, and require as adequate a demonstration of their etiology and as rational a treatment. Suppurative disease may elect this gland as its site, producing results whose correction will tax the resources of the most skillful operator. Congenital, and every form of general tumors, are to be met with in the parotid, and indeed of the several forms of disease common to glandular structures tuberculosis is the one which may be termed a rare finding. The location of the gland in the meshes of the facial nerve is another factor contributing to make its surgical treatment difficult, and its exposed position renders the production of scars highly undesirable for cosmetic reasons, especially in women, who cannot hide the traces of the knife under a growth of beard.

Anatomy.—The anatomy of the parotid gland is an unusual factor in its pathology, and contributes largely to its surgical interest. This subject may profitably be studied in any good anatomical text, but some few features are of peculiar importance from our point of view and worthy our special consideration. The gland is of unusual extent, and presents many anomalies. Ordinarily it exhibits at least one accessory lobe of gland tissue which may be supplied with a separate outlet opening into Stenson's duct, just anterior to the masseter muscle. In extent the parotid reaches from the zygoma above to the digastric muscle and styloid process below. It is traversed by the many-branched facial nerve, the tempero-maxillary vein, the tempero-auricular nerve, and the external carotid artery. Its secretion is received in Stenson's duct, which passing across the masseter empties into the upper part of the mouth in a line corresponding to the anterior margin of this same muscle. The duct can usually be felt here and its orifice seen in the cheek wall. The glandular elements are surrounded by a reticulum of connective tissue in which are lymph spaces and a vascular plexus, while situated on the anterior wall are three lymph glands of considerable size. In point of growth the parotid continues to increase in size from birth to middle age.

Retention Cysts.—Retention cysts in the parotid present a condition as interesting as it is difficult to treat. They appear as well-defined, fluctuating tumors in the region of the gland, sometimes, however, extending down into the neck, and even as far as into the pharynx. They are usually of a centimeter or two in

diameter, but may attain to the size of an orange. Among the early physiologists Viborg, Claude Bernard, and Gerlach attempted to produce artificial retention cysts in the parotid by ligating its duct, but in every case the gland atrophied and no cyst was formed. Pelschinsky repeated the experiment on horses, and in one instance on a man, with similar results. It was later demonstrated, and the result generalized as an accepted principle, that absolute and permanent obstruction of any duct causes an atrophy of its tributary gland, while partial or interrupted obstruction results in the formation of a retention cyst.

The diagnosis of retention cyst in the parotid is in most instances easily made. The tumor follows an injury in the region of the gland or of its duct, or it comes as a sequel of some infectious disease, such as mumps, diphtheria, or alveolar abscess. The tumor is tense, fluctuating, varying from the size of a walnut to that of a hen's egg or larger, and within these limits exhibiting inconstant change in dimension from day to day; rarely even subsiding altogether for a time. As a rule, the connection between the tumor and the duct may be made out by palpation, the tumor mass seeming to swing upon the gland as upon a fixed base. If the tumor is a small one it gradually forces its way out into the subcutaneous fat, or it elects the opposite course and appears in the mouth or pharynx. The cyst content is the parotid secretion, undergone degeneration, and usually filled with cholesterin crystals. In early cysts the enzymes of the parotid secretion may be recognized, but in those that have endured for some time a demonstration of these fer-

ments is no longer possible. Bouchand observed a parotid tumor in a boy of ten, from which he aspirated a considerable quantity of viscid fluid. An hour later the patient ate a good meal, causing the cyst to fill again. The tumor was immediately aspirated through the mouth and a fluid containing a large percentage of sugar was removed. As a result of the tapping the cyst became infected, suppurated, and broke through the cheek, producing a salivary fistula which healed in the course of a few weeks.

Albert (Lehrbuch der Chirurgie, Ed. IV., 1890, Vol. I., p. 364) reports a case in which a diagnosis of atheroma was made. In attempting the removal of the tumor it was found to be fixed to the parotid. It was opened, permitting the escape of a thin fluid containing cholesterin crystals. At the base of the tumor was a small opening, through which a probe was passed into Stenson's duct.

When retention cysts of the parotid are opened through the cheek, there results a salivary fistula, which occasions especial discomfort when the patient eats. The only hope of avoiding this condition lies in making the duct competent, or in extirpating the tributary gland elements. On account of its anatomical relations, extirpation of the parotid is a serious procedure.

Suppurative Parotitis.—Acute suppurative disease of the parotid may arise by direct infection through wounds, by the extension of an abscess, or by the extension of infection from the mouth. It is a most serious condition, and one difficult to treat. Its course is progressively destructive, and such cases as

receive inadequate treatment, or are allowed to heal spontaneously, exhibit through necrosis of the duct a fistula in the cheek wall; a condition alike disgusting to the patient and to the beholder.

Abscess of the parotid is fortunately a relatively rare disease, occurring for the most part as a complication or sequel of the acute infectious diseases, especially of scarlet fever in children and of typhoid in adults. In anemic and marasmic persons it may follow an attack of epidemic parotitis or mumps. It is reputed to occur consequent to operations upon the abdomen, but it is doubtful if the disease is more common as the result of protracted abdominal operations than protracted operations elsewhere on the body. In such cases it would seem to be the result of infection from the mouth, due probably to injury of the jaw incident to raising it, and to the wiping out of the mouth during the administration of ether.

A case which came under the care of Dr. Rudolph Teschan illustrates the course of the disease and the method and difficulties of treatment. The patient was a man 52 years old, who had led an active life, and who had never suffered any sickness so far as he could remember. He was making a journey in the fall of 1901, and passed the night in a cold sleeping-car, from which exposure he believes he contracted a neuralgia in the right side of his face. He noticed some difficulty in opening his mouth, and on the second day of his illness suffered of several slight chills, during which time there also appeared a swelling on the right side directly over the angle of the lower jaw. Swallowing became painful, and the poultices which the

patient had been applying gave little relief. On the third day after the initiation of the symptoms, he called Dr. Teschan, who found a temperature of 104, a rapid pulse, and all the indications of sepsis in an otherwise healthy man. There was a tumor covering the right side of the face and neck. It was red and edematous, and in one place near the angle of the jaw, fluctuating.

Dr. Teschan shaved the face and neck and made a vertical incision, beginning at the angle of the jaw and extending downward over the most fluctuating part of the tumor. Several drachms of pus, containing a glairy fluid, were evacuated. The wound was packed, and an antiseptic dressing applied. Following this procedure the temperature went down three degrees, and the general condition of the patient greatly improved; a low grade of sepsis still obtained, however. The patient became much emaciated during the succeeding three weeks, and more radical measures were decided upon.

I saw the man, in consultation with Dr. Teschan, in the first week of December. At that time the temperature was 107, and the pulse rapid. The mouth could be opened only far enough to allow of the introduction of the tip of one finger. The parotid duct was easily felt, but it did not discharge either pus or other secretion into the mouth. The region of the parotid gland from the zygoma to the middle of the neck was a thick mass of indurated tissue, painful upon pressure, and covered with a hypertrophied skin which over the center of the tumor was of a bluish tint. The incision at the angle of the jaw was almost

closed, but was still discharging pus. The mastoid and the ear-drum were examined to demonstrate the absence of middle-ear disease, and the lungs carefully examined to exclude the possibility of embolism from a thrombosed jugular. The hearing on both sides was good, both for contact and air transmission. A diagnosis of extensive suppurative parotitis and periadenitis was made, and an extirpation of the parotid and its duct was recommended.

The operation was performed a few days later with the assistance of Drs. Teschan and Bechtol. The field of operation was made as clean as possible with Schleich's marble soap, chloroform anesthesia was secured, and an incision made parallel with Stenson's duct, and reaching from the anterior border of the masseter muscle to the margin of the auditory meatus. The temporal artery was found to be obliterated, the glandular and periglandular tissues were enormously thickened, and the facial nerve with the pes anserinus was three-quarters of an inch below the skin. A vertical incision connecting this wound with the primary incision in the neck was now made, the skin was turned back in every direction, and the parotid tissue and the infected connective tissue were dissected out, together with a chain of infected lymph glands on the carotid and jugular. The duct of Stenson, just internal to its reception of the duct from the socia parotidis, was cut off and brought forward in the wound and all connecting glandular tissue dissected out from beneath the many branches of the facial nerve, from the zygoma down over the angle of the jaw to the spinous process and the digastric muscle.

Very little hemorrhage was met with during the operation, the large vessels being apparently obliterated by the infection. The wound was closed with a small amount of drainage where it would be least likely to produce an offensive scar. The operation consumed three hours. Healing was very rapid, and the wound was completely closed and the remaining tissues soft by the end of a month. The only paralysis that resulted from the operation was a trifling and almost unnoticeable drooping of the corner of the mouth. This was afterward entirely concealed by the beard and at no time did it produce any defect of articulation.

The result in this case was extremely satisfactory and compares very favorably with what might be termed by some the "conservative" treatment of a case which I have observed in one of my neighbors. In 1898 Judge J. suffered of some sort of infection in the left side of his face. It was treated by repeated lancing, and for a period of more than eighteen months he was in a state of remittant sepsis. During this time he was more than once reported to be in a dangerous condition from blood poisoning. He was confined to his house for weeks at a time, and was able to attend only to a limited amount of work in his office. I saw him on matters of business several times during the latter part of his illness, and on the first of these occasions he voluntarily removed the dressings of soft handkerchiefs with which the side of the face was covered. It was an easy matter to make a diagnosis of suppuration in the parotid, with fistula from several acini of the gland. There were five or six openings through the skin of the face over the parotid,

and from some of them clear parotid secretion and from others "laudable" pus was discharged. An area of redness and tenderness showed plainly the location of the infected gland. The muscles of the lower left side of the face were inactive, either from destruction or injury of branches of the facial nerve, or from protracted myositis. Four years after the beginning of the disease, and two years after all apparent danger of blood poisoning had passed, the patient was still obliged to wear a pad over his cheek to absorb the parotid secretion, which was especially abundant while he was conversing or at table.

If we attempt to explain the course of a suppurating parotitis by the pathological findings, we must at the same time consider the etiology and course of similar infections in such other glands as the pancreas, the liver, the kidney, and the testicle. In the great majority of cases the infection travels from the mouth through Stenson's duct to the secreting surfaces of the gland. At first the process is one of simple adenitis, but it quickly becomes one of obstructed adenitis on account of the limited area of the ducts and the large amount of unyielding connective tissue surrounding them. The first stage of the disease is the stage of greatest distension and pain. As suppuration progresses the secreting epithelium of the gland is destroyed and the abscess is surrounded only by the interglandular connective tissue. Because of the racemose character of the parotid this process is carried on in many parts of the gland at once, and all stages of infection are found in a single specimen. The sequence of conditions is, then, (1) simple catar-

rhal parotitis draining through the duct; (2) obstructed adenitis; and (3) periadenoid or cellular abscess.

The great vascularity of the parotid and the extremely small outlets of the acini explains the rapid course of the disease, and the reluctance with which a prolonged operation designed to extirpate the gland is so often viewed explains the very fatal results which follow suppurative parotitis. The fatality which attends the disease may readily be understood if we but bear in mind the debilitated condition of those suffering of parotitis as a secondary mixed infection, and also that the extent and firmness of the connective tissue surrounding the gland tends inevitably to the production of an early congestion necrosis.

Tuberculosis.—For a long time the salivary glands were held to be immune from tuberculosis. Its existence in the parotid has, however, been demonstrated, although the condition is beyond doubt a rare one. Owing to the limited number of cases recorded it is impossible to attempt any statement as to the relative frequency of the disease in the various decades of life; it may, however, be of interest to note that it has been observed in persons between 13 and 61 years of age. The lesions are generally local, and only in a few cases has coincident tuberculosis been demonstrated elsewhere in the body.

The pathologic process in the gland does not differ materially from that of tuberculosis in other tissues. Its progress is rarely accompanied by pain, but should destruction of the facial nerve be accomplished, there results inevitably a paralysis of those muscles whose

innervation is thus cut off. De Paoli reported two cases of tuberculosis of the parotid before the tenth congress of Italian surgeons, in 1895. In both instances there was a history of a nodular tumor of slow growth, producing neuralgia and paralysis of the facial nerve; and in both cases recovery followed removal of the tumor.

The microscopic examination in one of these cases revealed a tuberculous infiltration of the periglandular connective tissue and the facial nerve. De Paoli advanced the theory that the parotid secretion exercises a germicidal power against the tubercle bacillus, and this he supports not only by the findings in his cases, but also by showing that from five to twenty per cent of parotid secretion added to nutrient media retards the growth of the bacillus.

The symptoms of the disease are not very distinct. The tumor is the result of a slow and usually painless enlargement of the gland. In some cases the mass is fluctuating and in others it has a firmer consistency. The overlying skin is not reddened, is rarely edematous, and remains intact. Pressure upon the tumor is not often painful, and it sometimes demonstrates a communication with the mouth through Stenson's duct. Tuberculous infiltration of the adjoining lymph glands is not a coincident condition. In the only case which has come under my personal observation the disease followed mumps. The diagnosis is beset with difficulties and can be established only by a demonstration of the bacilli. The disease is closely simulated by syphilis, sarcoma, mixed tumors, and dermoid and salivary cysts.

The prognosis is favorable. The treatment consists in removal of the infected tissues. This may in some instances imply the extirpation of the parotid, while in others a simple incision and evidement may accomplish the desired result.

Dr. Jacob Frank reported a successful operation upon a child twenty-two months old. The microscopical findings confirmed the diagnosis. He gives (Chicago Med. Recorder, July, 1892) a table of eight cases collected from the literature.

Tumors.—The most interesting and the most important tumors of the parotid are the so-called mixed tumors. In the older literature they were described as chondromas, sarcomas, and cysto-chondrosarcomas. The mixed tumors of the parotid are usually observed during the second and third decades of life, though they are often observed at birth and during infancy. They are without doubt of congenital origin. They are more frequently observed in females than in males, and they appear more often upon the left than upon the right side. Trauma and inflammation seem to have something to do with the appearance of the tumor.

Mixed tumors in the parotid are usually sharply outlined and more or less movable; their location is either in the midst of the gland itself, or sometimes at its border, so far away that they appear in the neck or pharynx. They frequently attain a very large size, and they are usually of a round or oval form, and have a smooth, nodular appearance. Their consistency is various, sometimes hard and firm, sometimes soft and fluctuating, or pseudo-fluctuating.

PLATE IX

A case of probable parotid tumor, of 20 years standing. It began as a pea-sized tumor of the parotid region, and gradually grew to 18 inches in diameter. It was removed without resulting paralysis of the face, by Dr. Parker. Fox and Sturgis' Illustrated Medicine and Surgery, N. Y., 1893.

The mixed tumors of the parotid are almost always well encapsulated, and the cut surface shows a variegated appearance. In the midst of sarcomatous or carcinomatous masses are lakes of myxomatous tissue and cysts, and masses of cartilage. The relation between the parotid and the tumor is various. In some cases the tumor is centrally located, and in the beginning completely surrounded by the gland. In other cases it is only attached to the gland by a firm pedicle, and is located anywhere in the region of parotid tissue. It is found in the neck, under the jaw, behind the angle of the jaw, in the pharynx, and in the cheek wall. The tumor is usually single, but sometimes it is multiple.

Microscopically the tumors present all of those characteristics which we find in mixed tumors of epithelial and connective tissue origin. They contain masses of cartilage, sometimes in such abundance that the tumor would be looked upon as a chondroma. In other cases the adenoid tissue is so abundant that it seems to be an adenoma.

The prognosis in cases of mixed tumor of the parotid is relatively favorable, but it must not be forgotten that these tumors show a tendency, without any recognizable provocation, of suddenly becoming malignant.

The treatment consists in careful, complete, and thorough removal. This may entail the extirpation of the parotid with all of its difficulties and dangers.

Adenomas appear in all forms, from a simple hypertrophy of the parotid to an actual malignant tumor. The condition, however, is relatively rare, and most

of the cases of so-called adenoma of the parotid are mixed tumors. They are of little clinical and pathological significance.

Carcinoma of the parotid is extremely rare. Only a very few cases have been observed. They are rapid in their progress, and operations upon them are extremely unsatisfactory. In a few cases they have produced paralysis of the facial nerve at a very early stage, making this symptom an unfavorable prognostic sign.

They are difficult to diagnose from mixed tumors of the parotid. Any effort at removal necessitates an extirpation of the parotid gland, and the destruction of the facial nerve.

Fibromas, lipomas, and myxomas are occasionally found in the parotid gland, and even a rhabdomyoma has been observed by Prudden. They are of little clinical significance.

Angioma and lymphangioma are very rare in the parotid gland; they are rather tumors of the parotid region than tumors of the parotid itself. Hartmann reported nine cases of angioma in 1889, but some of them are questionable. The microscopical picture was that of a subcutaneous angioma, in the meshes of which bits of parotid tissue were included. Bidone found the angioma occupying the deep substance of the gland.

Lannelongue observed similar cases of lymphangioma. The prominent, fluctuating, and translucent tumor was of a light bluish color, and histologically it was found to be composed of lymph tissue, in the interspaces of which bits of parotid were included.

When these tissues are met with, they require extirpation in proportion to the degree of disfigurement they produce.

Hartmann. Contribution à l'étude des angiomes de la région parotidienne. Revue de chirurgie IX., 1889, S. 756.
Lannelongue et Achard. Traité des kystes congénitaux. Paris 1886.

CHAPTER XV

FACIAL NEURALGIA

The problem; symptoms; anatomy; surgical treatment, radical and palliative.

The etiology of neuralgia is an unknown quantity. It originates in the course of the infectious diseases, especially in influenza. It occurs in diabetes, rheumatism, and rarely in syphilis, and in general arteriosclerosis. It occurs also in the perfectly well without known cause and as a result of trauma or exposure to cold. It may be present in lead, mercurial, and alcoholic poisoning, and in those suffering from excessive use of tobacco. We are uncertain whether the disease begins in the periphera, as a sort of neuritis or perineuritis, or centrally, as periostitis, or as a result of pressure by tumors or aneurisms. In some cases the peripheral site of the disease is suggested by the presence of scars, foreign bodies, or neoplasms in the distribution of the afflicted nerve. In other cases, when after cold or traumatism the neuralgia involves all three branches of the fifth nerve, at once and most persistently, the most reasonable site to be assigned the disease is the ganglion itself, or a point just distal to the ganglion where its branches are yet in close proximity, or some point more centrally located. There is some relation between facial neuralgia and diseases of the teeth, of the accessory sinuses of the

nose, and the condition known as auto-intoxication, but the relationship is not well understood. The histological condition found in the excised nerve does not throw much light on the pathology of the

86. Cutaneous, sensory nerves of the head and face (after F. Krause). The regions of the 1st and 3d branches of the trigeminus hatched, the region of auricular branch of the vagus in black. 1, 1st branch of trigeminus: 2, 2d branch: a, infraorbital; b, zygomatico-facialis; c, zygomatico-temporalis; 3, auriculo-temporalis, 4, occipitalis major; 5, occipitalis minor; 6, great auricular; 7, posterior cervical; 8, lateral cervical; 9, auricularis vagi.

disease. The findings are not at all conformable to the symptoms.

Facial neuralgia is the most serious, and excepting the ischiadic neuralgia, the most common form of this painful and obscure disease. The essence of neuralgia is the pain confined to the distribution of one nerve or to a single branch of one nerve. The pain may be mild or severe, and is often of a paroxysmal character.

It is often preceded by an aura, an itching, or stiffness of the subsequently affected area. In many cases the pain is sudden and wholly without warning. Each paroxysm is like its predecessors. The intervals are usually free from pain, but they show a tendency to become shorter and shorter, until the fresh paroxysm may begin before its predecessor is ended. The pain is hard to describe; sometimes it resembles the thrust of a knife, or the boring of a hot iron, or again, it is lighter, but grows in intensity with any movement of the face, and even with the slightest motions of breathing—a touch is sufficient to bring on a paroxysm. In the early stage of the disease the pain is less severe and frequent, and the intervals are absolute intermissions. Later the paroxysms are more intense and the intervals are remissions in the relative sense only. The night is usually free from pain in the earlier stages of the disease, but later neither night nor day is exempt. The skin of the face undergoes dystrophic changes, and the mind becomes affected by the terrible suffering. Suicide is a common and a not unpardonable recourse.

In all but the most severe cases there are tender spots to be found over the distribution of the affected nerve. As a rule they are located at the point of exit of the nerve from a denser to a rarer medium. The supraorbital notch, the palpebral point on the upper lid, and the nasal point on the bony lateral wall of the nose are well recognized points of extremer pain. There are two points in the course of the infraorbital branch, one over the infraorbital foramen, and the other on the upper lip just below and lateral to the

ala of the nose. The point of the chin over the mental foramen, the entrance of the nerve at the angle of the lower jaw, and a point about the tragus are hypersensitive in inferior dental neuralgia. There are a few remaining points of but scant diagnostic value.

Very frequently, in the onset of the disease, the pain is confined to a sharply circumscribed area in the distribution of the affected nerve or nerve branch, but with the progress of the disease it spreads to the distribution of adjoining branches. This is the so-called "radiation phenomenon."

The diagnosis of facial neuralgia should be made only after the most careful and painstaking investigation. The patient's history must be obtained in detail, and any evidence of syphilis, general paresis, disease of the accessory sinuses of the nose, or of the teeth and jaw must be eliminated. Tumor of the brain, aneurism of the aorta, or any inflammatory process in the bone at the base of the skull should be entirely excluded. An examination of the blood-vessels at the temple, wrist, and in the popliteal space; an analysis of the urine; a pulse tracing, and an examination of the heart will serve to exclude general vascular sclerosis, while hysteria and diseases of the central nervous system should be borne well in mind during the general examination. Auto-intoxication and disease of the petrosa should be considered in their causal relationship; the former to be eliminated by the use of castor oil, and the latter by thorough inspection of the ear. Any case of supposed facial neuralgia occurring in the very young deserves to be viewed with great suspicion. An absolute diagnosis is impos-

sible so long as we are unacquainted with the pathological motive of the disease: the diagnosis must always be looked upon as clinical and relative.

The prognosis of facial neuralgia, so far as life is concerned, is very favorable. As concerns recovery, however, unless the treatment consists in the most radical surgical procedure, the prognosis is most unfavorable.

Many patients suffer of neuralgia for years and yet appear to be in perfect health. Again the disease may have begun in a cachetic and neurasthenic individual, and the anemia, cachexia, and neuresthenia thereby increased. Death as an immediate result of neuralgia is unknown, and in every case where it has been suspected, a careful examination has shown some organic lesion within the cranium.

The prognosis after surgical treatment is much more favorable. The disease is arrested in many cases by the removal of single branches of the facial nerve, especially when the pathological condition has not been rapid in progress, nor long in duration. These limited operations result more favorably in the young than in the old or anemic. Many of those requiring surgical intervention have already acquired the morphine habit, and this condition is not of necessity eliminated by relief of the neuralgia. In severe cases of neuralgia, in those of long duration, and those in which more than one branch of the nerve trunk is involved, permanent benefit is to be secured only by removal of the ganglion.

When a patient in any stage of facial neuralgia comes into the hands of the surgeon, careful and

repeated examinations should be made to determine the extent of the disease, its ordinary remissions and exacerbations, and the modifications which may be secured in its intensity by means of diet, baths, and intestinal antiseptics and laxatives. Castor oil has gained a marked distinction in the treatment of all forms of neuralgia, and it should be freely and continuously employed. Particular attention should be given to the condition of the mucous membrane of the nose and its adjoining sinuses. The teeth, gums, alveoli, and the jaw itself should be made the subjects of a rigid examination; the mouth and its contents thoroughly and repeatedly cleansed; and particular care should be exercised in securing complete removal of all deposits upon the teeth, and of all disease within the roots of dead teeth. If the patient is suffering of middle-ear disease this serious condition must be cured before any surgical treatment of the neuralgia is undertaken. Since malaria is a frequent forerunner, or possibly a cause, of facial neuralgia, treatment with quinine, arsenic, and a series of eliminative baths, should be instituted prior to operative procedure, especially if the patient has resided in a malarious country, and wholly independent of the fact that an examination of his blood may yield no evidence of the disease. Because of the difficulties in diagnosing the later forms of syphilis, and in view of the fact that the most skillful diagnosticians often fail to recognize the disease, it is well to give each patient the advantage of a radical anti-syphilitic treatment, especially when the symptoms of neuralgia are in any way atypical.

In anemic individuals, and in the case of those

suffering from indigestion, it is very desirable to treat these conditions rationally and preclude the possibility that the neuralgia is secondary to the anemia, or to the starvation incident to indigestion. The teeth should be put in condition for proper mastication, and in the case of aged persons who have had their teeth removed on suspicion that their decay was the cause of the neuralgia, an artificial plate should be fitted and every opportunity given the patient to recover from the gastritis, and the secondary anemia which it entails. If the patient has become addicted to the use of morphine, baths, dietetic measures, and such surroundings as will preclude the use of the drug should be instituted and the patient cured in so far as possible from the effects of morphinism before radical operation is undertaken.

The surgical treatment of facial neuralgia may be put down as radical when the ganglion is removed, and as palliative when excision of a single nerve branch is practiced. The former procedure is to be recommended in every case of so-called central neuralgia, and the latter may be advised when the disease is periperal and confined to a portion or the whole of the distribution of one of the branches of the fifth nerve.

The excision of the supraorbital nerve is to be performed when the pain is confined to the forehead and scalp not farther back than the occiput, or to the skin on the bridge of the nose and as far down as the tip. When the whole of this area is subject to pain the nerve must be removed from the point of its entrance into the orbit, and posterior to the nasal branches.

The operation is performed by making an incision in the natural folds of the upper eyelid from the canthus upward and outward to a point half an inch beyond the outer border of the orbit. The connective tissue is carefully separated with the dissecting forceps until the nerve is recognized lying in the upper part of the orbit, in close proximity to the ophthalmic artery. It should then be grasped with the forceps and the tissues dissected away to the very entrance of the nerve in the upper, posterior part of the orbit, when another forceps should be applied and the nerve twisted and pulled out. The only danger in the operation is that of injury to the ophthalmic artery or one of its branches, from which a terrible hemorrhage, and one difficult to arrest, is likely to occur. The chances of success are dependent upon conditions which it must frankly be admitted we do not understand. It is certain that the nasal branch of the supraorbital nerve must be removed or the neuralgia will return in the skin over the bridge of the nose, and in the region of the medial end of the eyebrow. The excision of the nerve outside the orbit cannot be recommended. When there is a suspicion that the frontal sinus is responsible for the neuralgia, it may very safely and pertinently be opened through the primary incision and this possible source of the disease excluded. A very guarded prognosis must be given after the operation.

In facial neuralgia confined to the distribution of the infraorbital nerve it is sometimes desirable to excise the second branch of the trifacial. When this has been decided upon, a rather long incision is made

parallel with the levator anguli oris muscle, and over the infraorbital foramen. The incision must be at least two or two and one-half inches long. The muscle is drawn toward the nose and the skin is cut, beginning directly over the infraorbital foramen and extending toward the ear at a right angle to the first incision. In this manner the nerve may easily be reached and a silk thread tied around it close to the foramen. After clearing away the anterior surface of the antrum of Highmore, this cavity should be opened with hammer and chisel or a small trephine just below the foramen. With a rongeur forceps the foramen should be opened into the antrum, and with the chisel and hammer the whole infraorbital canal, and that portion of the floor of the orbit where the canal becomes a groove, should likewise be opened into the antral cavity. The capillary oozing may be controlled with hot sponges, and the little finger passed in through the opening made in the anterior wall of the antrum, and the condition and location of this part of the canal demonstrated. The posterior wall of the antrum should then be perforated with the chisel and hammer, or with a bur, and the nerve freed from its attachments in the posterior opening of the infraorbital canal. Now that the nerve is free it should be held loosely in a slim, toothed artery forceps, which should be applied externally in the wound and slipped back through the antrum into the spheno-maxillary space and firmly clasped upon the nerve, which is then twisted and pulled out. The wound is packed to arrest the almost inevitable hemorrhage, and the antrum is drained into the mouth in the region of the

canine fossa. The wounds in the cheek are completely closed.

The greatest danger incident to the operation is that of hemorrhage in the spheno-maxillary fossa from injury to the maxillary vessels. The number of recoveries after operation for infraorbital neuralgia seems to be greater and more permanent in character than is the case in neuralgia of the other branches of the trifacial. This is perhaps due to the fact that the antrum is always opened and any disease which it might have harbored is removed.

Excision of the inferior dental nerve is accomplished in two ways: Dr. Brophy has practiced one method and surgeons in general have employed another. Dr. Brophy anesthetizes the patient, pulls down the lower lip, makes incision through the mucous membrane, and if necessary chisels a small cavity in the body of the jawbone so as to open freely the mental canal. He then reams out the canal with a bur upon the side where the removal of the nerve is to be undertaken. One long steel broach after another is then thrust into the inferior dental canal until it is completely filled. He then wraps a bit of adhesive plaster about the handles of these instruments, carefully twisting and withdrawing them at the same time, thus bringing with them the inferior dental nerve which is extracted entire. Dr. Brophy reports many recoveries from this operation, and it is so attractive in principle and so simple in execution that its practice ought not be neglected.

The common operation for the removal of the inferior dental nerve is a bloody, deforming, and seri-

ous procedure. It is not unattended by danger to the facial nerve and parotid gland. An incision is made behind the angle of the jaw, and parallel with the ramus, as low as possible without touching the facial artery. The tissues are carefully dissected aside, exposing the body of the jaw and the lower half of the ramus. A small trephine is applied over the angle of the jaw, and the inferior dental canal and foramen are exposed. The nerve is grasped in the foramen, and with a dental bur, or a chisel and hammer, it is approached to a point as far forward as possible. It is then removed from its canal and with a blunt instrument is followed as far back toward the base of the skull as the conformation of the canal allows, when it is grasped with forceps and twisted out.

The complications in this operation are hemorrhage and an inability to follow the upper portion of the nerve for any considerable distance. Relapses after the operation are frequent, and a most guarded prognosis should always be given.

The radical operation for facial neuralgia consists in the removal of the Gasserian ganglion by an osteoplastic resection of a portion of the skull. This operation was first performed by Edmund Andrews of Chicago, and by Hartley of New York, and was afterwards perfected by Fedor Krause of Hamburg.

The operation is performed in essentially four stages. The first stage is the opening of the skull. A large, curved incision is made as for the purpose of approaching the middle meningeal artery, beginning at a point as near the zygoma as possible and extending upward and backward for two inches, then forward

for a distance of two inches, and finally downward to the zygoma an inch and a half in front of the starting-point. The scalp is retracted so as to leave a quarter of an inch of the skull bare. A small trephine is applied to the bone at the lower anterior angle of the incision, and a button of bone removed. The dura is pressed forward and the DeVilbis rongeur is inserted and the tract of denuded bone followed around its periphery to the lower, posterior angle. The base of the bone flap is broken off by inserting one or two chisels under its edge and lifting it up. The sharp flexion of the pedicle of the flap arrests all hemorrhage. Small arteries in the concave surface of the scalp should be ligated.

The second stage of the operation consists in ligating the middle meningeal artery at the point where it enters the base of the skull. With an aneurism needle a strong, fine catgut or silk ligature is thrown about the artery while the brain and dura are retracted upward by a smooth bifid retractor in the hands of an assistant. In this manner two ligatures are placed about the vessel, and the artery and dura are cut between them. Occasionally a second and anomalous branch of the artery must be ligated. Should the operator fail to secure the middle meningeal, especially its lower end, the hemorrhage may be controlled by plugging the foramen spinosum with a pledget of iodoform gauze at the point of the finger. This procedure is facilitated by using a short, blunt hook in crowding the tampon downward and outward into the canal.

The third stage consists in laying bare the ganglion

and removing it. Beginning where the dura, together with the artery, has been cut between the ligatures, the incision is extended in both directions, and the brain carefully retracted upward, laying bare the roots of the trifacial nerve at their point of exit from the cranium. With blunt instruments the ganglion and its nerve branches are detached from the dura and adjoining tissues, the nerves severed as they leave the cranium, and the ganglion with its nerve trunk pulled forward into the wound and cut off. This portion of the operation is greatly obscured and impeded by the profuse capillary and venous hemorrhage. The wound is packed with hot sponges for a few minutes to stop all bleeding, and the dura is closed partially or completely in proportion to the relative amount of oozing.

In the fourth and last stage the bone flap is brought back into place and drainage secured where the little button of bone was removed. The edges of the primary incision in the scalp are nicely approximated and an antiseptic dressing applied.

The great danger throughout the operation is from hemorrhage, and this is most likely to occur from the lower end of the middle meningeal artery. On its absolute security depends the safety of the patient. Hemorrhage from the veins and sinuses of the dura is not so dangerous. Injury to the carotid artery in the course of this operation must be regarded as a blunder, or at best as a mournful accident.

The only warrant for the terrible operative procedure above described lies in the almost absolute relief from pain which it affords, and the desperate condition for which it promises the only amelioration. The

average length of the operation is from two to four hours, and the least time in which it has been accomplished is fifty-five minutes. Most of the time is spent in stopping hemorrhage, and in meeting unexpected difficulties.

Dr. A. E. Halstead has operated, according to the Krause method, in six cases of facial neuralgia, four of which were wholly successful in result. In one case death followed within four days from uremic intoxication, and in the remaining case from meningitis, six days after operation.

LITERATURE

The literature of facial neuralgia is as extensive as the disease is obscure. Up to 1896 the literature may be found in Fedor Krause's monograph, Die Neuralgie des Trigeminus Leipsic, 1896.

CHAPTER XVI

CARCINOMA OF THE TONGUE

Introduction to study of carcinoma; status of medical science at the beginning of the nineteenth century; the contributions of Virchow and Pasteur; our ignorance of the nature of carcinoma; statistics of carcinoma in various civilized countries; relative prevalence in various decades of life; etiological factors; course; duration of life. Symptoms of carcinoma of the tongue; diagnosis; differential from syphilis; recurrence; surgical treatment; prognosis; illustrative case; conversation of Johnathan Hutchinson. Literature.

In the previous chapters, excepting only that on tumors of the brain, we have dealt with problems which medical science more or less completely explains, and in relation to which it exercises a very definite procedure and control. It is significant further to note that this felicitous condition has obtained only since a date surprisingly recent as compared with the antiquity of the healing art. The most superficial reading of the history of medicine will suffice to show the student that the heritage of the present-day physician consists overwhelmingly of the fruits of modern research; his debt of actual knowledge to the past is a very small one. With the partial exception of the subjects of simple fractures and dislocations, and the clinical history of the exanthematous diseases, the col-

lective medical lore of the early part of the nineteenth century was a phantasmagoria of illusion, mystery, and superstition. Very little of present value to medicine antedates this period.

The modern epoch may be said to have had its beginning in 1820. The early half of this decade witnessed the birth of two men destined to revolutionize the practice of medicine and surgery; to bring order out of confusion; to dispel illusion and substitute for it the real. By virtue of their work medicine has become worthy the name of science, and surgery has come to occupy its present position of surety. Virchow, in 1852, published his cellular pathology and at that moment consigned to oblivion the pathological and most of the clinical work of his predecessors and contemporaries. Not until 1874 did Pasteur demonstrate to the world the biologic origin of the infectious diseases, but the investigations which preceded this announcement were begun ten years earlier. To this man surgery owes most. He gave to the surgeon that knowledge of biologic facts which makes it possible for him to perform any operation, however extensive, which the mechanical necessities of life do not deny, and this without fear of the wound diseases which were expected and even encouraged by his predecessors.

The entire field of fractures and dislocations, the etiology, course, and even the prevention of some of the infectious diseases, and the processes of inflammation and repair are now definitely known. There still remains, however, one chapter of medicine which is as illegible to us to-day as was the entire tome to

our ancestors of a century ago. It is a field of speculation, mystery, and gloom.

There are many reasons why the subject of cancer demands careful consideration from the student. Its etiology is shrouded in uncertainty. Of all diseases commonly met it is the most deforming, revolting, and agonizing. It attacks both the mature and the old, and its ravages increase with advancing age. It contributes a very large proportion to the death-rate of every civilized people, and strangely enough it seems to be increasing in frequency not only among the various race-groups of our own country, but as well among all nations from which vital statistics are obtainable. It would seem that the fact of this increase cannot satisfactorily be explained on the basis of the greater longevity of modern life, and certainly the suggestion of errors in diagnosis offers a solution no more acceptable. In former times many varieties of skin tuberculosis and syphilis, now properly denominated, were confounded in the vital statistics with cancer.

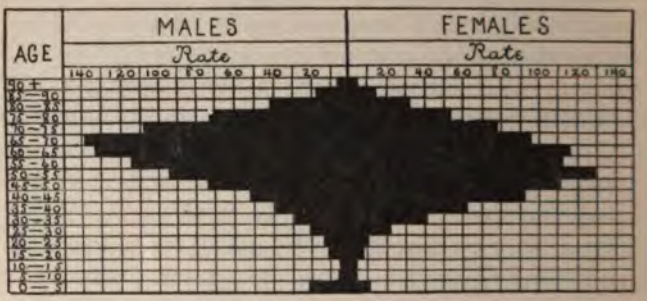
It is to be regretted that our profession has not arrived at that degree of scientific accuracy which would allow the statistics of the country to distinguish between carcinoma and sarcoma. Usually in census reports both conditions are referred to as cancer. In some of the tabulations cancer and tumor are grouped together. The best that can be done is to report the statistics as they are given, keeping always this source of error in mind.

The student who would consult vital statistics to any profit must recognize the regularity and uniformity characterizing the life histories of the various

peoples comprising the human race. The form in which these statistics are presented is sometimes confusing. The death-rate is usually given as so many to each 1,000 of living population. On this basis the average death-rate for the world is about 20 to the 1,000. The number of deaths from particular causes is computed on a basis of 100,000, fractions being in this manner more easily avoided. The following statistics are presented with a view to showing the number of deaths due to cancer in the city of Chicago, the proportion of deaths from cancer in the various civilized countries of the world, and the chances of death from this cause in groups of individuals during the successive decades of life. It will further be attempted to show the most frequent anatomical sites of cancer, and to demonstrate the relative position of cancer of the tongue as regards its general frequency, and its tendencies to occurrence in the sexes.

The report of the Department of Health of the city of Chicago for 1894 shows that of a population of a little more than 1,500,000, there were 640 deaths during the year attributable to cancer. According to the report on vital statistics of the census of 1890, there were during the census year 875,521 deaths from all causes in the United States; this was computed to be at the rate of 13.98 to the 1,000 of living inhabitants. Of these deaths 18,536 were due to cancer; 6,958 being males, and 11,178 females, and the rate was fixed at 53 in each 100,000 of population. During the same year the death-rate for cancer in England and Wales was 67.5, in Ireland 45.7, in Scotland 60.6,

in Italy 42.8, in Prussia 43.1, and in Austria 52.8 to each 100,000 of living population. The following diagram from the United States report on vital statistics of the eleventh census, p. 340, shows the number of deaths from cancer and tumor, per 1,000 deaths from all causes, at each interval of five years, and including all ages. It will be observed that the



87. Comparative proportions of deaths, male and female, in each age group, due to cancer and tumor, in the United States during the census year 1890.

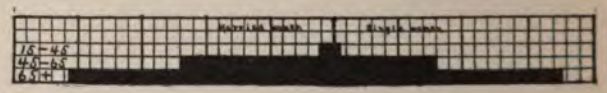
death-rate increases from the fifteenth to the sixty-fifth years of life, after which it diminishes; but it must be borne in mind that this diminution is apparent, not actual, and is to be explained on the ground that relatively few persons attain to so advanced an age. As a matter of fact the chances of death from cancer increase from the beginning to the end of life.

Of the total number of deaths from all causes 2.2% are attributable to cancer. Very few of those suffering this disease die before attaining the age of fifteen. Between the ages of forty-five and sixty-five the

88. Deaths from cancer in United States, per 1000 deaths from all causes. (Census report, 1890.)

ratio is 5.7%. Among the negro population of this country the number of fatalities from this cause is much lower than among the whites. The geographical distribution of cancer is world-wide, but the death-rate in different countries is not so uniform. The distribution in the United States is shown by the accompanying diagrammatic map.

In men the greatest number of deaths resulting from cancer are due to the presence of the lesion in



89. Deaths from cancer in women, per 100,000 of living population. (Report on Vital Statistics, census of 1890.)

the stomach; 404 in every 1,000 cases of cancer being of this variety. In women cancer of the uterus is similarly responsible, causing 312 in each 1,000 deaths from the general disease. Cancers of the mouth and tongue follow next in order of frequency and fatality with, however, a great discrepancy between the sexes, there being 104 deaths in men as against but 16 in women in each 1,000 deaths assignable to cancer. Among 4,600 cases of carcinoma collected indiscriminately by Jessell, there were 400 cases of cancer of the tongue, or 8.5%. In England, with a population of 31,000,000, there were in 1897, 24,000 deaths from cancer, of which 9,500 were males and 14,800 females. The total number of cancers of the tongue was 550; 477 males and 73 females. It will be observed in this, as well as in related tables of statistics, that cancer of the tongue predominates in males to an extraordinary

degree, a conservative estimate giving it a relative position, as regards frequency, of third in men and fourth in women. As is the case with this malady when occurring in other parts of the body, cancer of the tongue is most frequent between the ages of forty and sixty-five, but as we have already seen, the danger to life from this cause increases with age.

There would seem to be no difference in the tendency to cancer in the various walks of life. As regards rank both the upper and lower classes seem equally susceptible to cancer of the tongue, and the cigar and the pipe have respectively been assigned as etiological factors of prime importance. The preponderance of the disease in males would seem to support this hypothesis. In both classes syphilis is apt to produce an ulcer determining the localization of the cancer.

The etiology of carcinoma is an absolutely unknown quantity. The study of carcinoma has been prolific of the bulkiest literature. Pathologists have considered only the morphology, progress, and termination of the disease. Clinicians have devoted their attention to the diagnosis, course, and result of treatment. Hygienists have studied its dissemination and made many attempts to decipher its etiology. After nearly fifty years of active study, since it was removed from the syphiloids, it still remains in a disputed position. A few claim that it is a constitutional disease; more writers and operators believe it to be primarily local; later general. There are many reasons which have led to the prevalence of the latter opinion.

It is not necessary to suppose that all cases which are clinically and histologically denominated carcinoma

are biologically identical. It may yet be discovered, when a biological study shall have demonstrated their ultimate cause, that a certain moiety of these neoplasms must be set aside, as actinomycosis and rhinoscleroma have been; but the great majority are so uniform in their onset, course, histological and pathological history, that they will doubtless rest on one biological cause.

The history of this disease shows that its first appearance is usually in a single small point, and not at many points; that it is not preceded by a term of cachexia or constitutional disturbance, but that it is followed by general symptoms of disease, and spread of the growth in loco. The course of carcinoma is rapidly fatal, and its rapidity depends upon the locality of the primary lesion less than on the histological character of the tumor and the consequent spread of the growth. The fact that carcinoma rarely appears in the earliest and the middle periods of life intensifies the fact that the period of infection begins after the reproductive stage is past. From statistical and clinical evidence it appears that carcinoma frequently succeeds the following conditions:

1. Traumas of various kinds.

2. Irritation, transient as well as protracted, such as foreign bodies, carious teeth, gall-stones, burns, tobacco smoke, soot, petroleum, and paraffin.

3. Scars of all kinds, as for example, after burns, after lupus, after bed-sores, and operation scars.

4. Ulcers, especially ulcers of bone, lupoid ulcers, syphilitic ulcers, and ulcers of the stomach and esophagus.

5. Benign tumors, such as retention cysts, papillomas, syphilodermas, and warts and calluses.

6. Chronic inflammations of the skin and mucous membranes, such as xeroderma pigmentosa, seborrhea senilis, psoriasis, leukoplakia, and eczema.

The most superficial perusal of the literature of malignant tumors will satisfy any reader that in the mind of the patient and the historian these six circumstances are frequent causes precipitating the onset of carcinoma. Exactly what proportion of all cases of carcinoma is preceded by one of these factors, a study of the statistics will not answer. It must require the study of a new series of cases with this object in view. It is no argument against the causative relation of these factors to carcinoma that thousands of individuals suffer such irritation without the precipitation of cancer thereby. There has been, therefore, a tendency among clinicians to look upon carcinoma as a result of irritation. It seems absolutely certain that some carcinomas are thus brought about. This is especially noticed in the frequency of cancer on the lips of smokers at a point where the pipe or cigar is held. Virchow, according to Kubassoff, long ago spoke of carcinoma as a sort of infection, and there is a prevailing opinion among the people that picking a mole or pimple may cause it to become a cancer. The irritation of tobacco smoke in the fauces has been considered by some clinical observer the predisposing cause of cancers in this part. Gastritis and duodenitis frequently precede for a long time cancer of the stomach, and the presence of gall-stones is often coincident with cancer of the biliary duct.

The part which irritation plays in determining the localization of carcinomatous infection is illustrated in two cases reported by Zahn. (Fortschritte der Medicin, 1890.) In one the irritation of a depressed fracture of a rib produced carcinoma of the contiguous surface of the liver. In the other an old adhesion between the liver and the colon was the irritative cause. The irritation in an old ulcer has long been looked upon as a predisposing cause of carcinoma. Eberth demonstrated the infection of an old ulcer of the heel after the recovery of two contemporaneous ulcers on the same foot.

In substantiation of the infectious character of carcinoma, Kubassoff mentions a case of carcinoma of the upper lip, associated with carcinoma of the gums, the tongue, the esophagus, and stomach. (Klebs.) He has himself known of cases in which there was extension of the disease by direct contact. Kraske reports cases of cancer high up in the rectum, which were separated by sound tissue from cancer of the anus, and he looks upon the higher as the primary, and the lower as a secondary implanted disease. Isreal demonstrated cancer of the duodenum in a case of cancer of the tongue. von Bergmann demonstrated cancer of the lower lip which was followed six weeks later by cancer of the upper lip at the point of contact. Williams demonstrated the inoculation of the left thigh with cancer from the same disease on the inner side of the right thigh. Laslett (British Med. Jour., December 13 1890), reports a case of infection of the penis from cancer of the uterus. Hooper May (ibid.) reports an analogous case, in which some time after

the death of his wife from uterine cancer, the husband developed the disease on the penis.

In an article entitled, "Ueber Multiples Auftreten Primärer Carcinome," Dr. C. Schimmelbusch gives histories of many interesting cases collected from the literature and observed by himself. These are histories of indubitable carcinomas. They are certainly not metastatic. Many of them show evidence of transfer from one place on the body of the patient to another place. In one of these cases (Moxon) we find a flat-celled carcinoma of the esophagus breaking through into the trachea with several foci of carcinoma of the same kind in the lower lobes of the lungs. Another very similar case is taken from Erbse.

A very positive argument for the establishment of the infectious character of carcinoma is to be found in the investigations of Hanau and Hahn. They succeeded in inoculating cancer from one animal to another. Wehr succeeded in inoculating three dogs with carcinoma from human beings. One dog died of cancer, and the remaining two showed cancerous nodules. Budd reports a case of transmission of cancer from man to dog in a remarkable manner. The man suffered from carcinoma of the lip. The dog was accustomed to lick the sore and later developed carcinoma of the tongue. Hahn also implanted from the breast three pieces of carcinoma on other parts of the body of the same patient, where they readily grew.

A chemist's argument in favor of the infectious character of carcinoma has been demonstrated incidentally by Fr. Müller. (Stoffwechsel Untersuchung bei Krebskranken, 1890.) He shows that in carci-

nomatous patients the nitrogenous excretions exceed their income, that the chlorides are diminished even when the patients are fed excessive amounts, and that they are less than in healthy persons who are abstemious. He considers that the changes in the excretions are due to a poison generated by the carcinoma. His attempt to obtain from cancer nodules such poisons as would dissolve the albumens were without positive result. Feltz and Klemperer have found the injections of urine and blood from carcinomatous patients to produce toxic symptoms in animals, while the same products from healthy individuals are without noticeable effect.

Since 1896 there have appeared at tolerably regular intervals not a few announcements of the isolation of the specific "germ" of carcinoma, but in no case has the claim of the discoverer been verified by the findings of subsequent investigators. We must admit that at the present time we are no nearer the solution of the problem of carcinoma than we have been at any period in the past.

The hereditary transmission of carcinoma is not demonstrated. The general vital resistance of members of different families is undoubtedly favorable or unfavorable to the development of this disease.

Syphilis and tuberculosis seem to predispose to cancer in three ways: by furnishing an ulcer in which carcinoma arises, in diminishing the general vital resistance of the patient, and in furnishing children who have a low vital resistance as life advances.

The course and development of carcinoma is always progressive and the prognosis is always unfavorable.

The duration of life is in a large measure dependent upon the location of the tumor and upon the characteristics of its growth, and is measured by months, rarely by years. Taking carcinoma as a whole, the patient may be expected to live not more than two or two and one-half years after the first appearance of the tumor. In very exceptional cases the unhappy patient survives for 5, 10, 15, and even 25 years. In more cases than survive the average of two and a half years death releases the sufferer in six months or less.

CARCINOMA OF THE TONGUE

The surgery of the tongue is confined almost entirely to the excision of carcinomas. In early life the physician may be called upon to relieve a so-called tongue-tied child, and under unusual circumstances an abscess may be discovered in the tongue, but upon the whole the one condition for which operation is called for is carcinoma. This disease usually appears on the side or edge of the tongue, involving the dorsum. It is considerably more frequent on the right than on the left side. Rarely it appears on the posterior part of the tongue. The growth is of the flat-celled epithelial variety usually called epithelioma. It resembles in the early stages, both in appearance and location, syphiloma of the tongue, and this similarity constitutes almost the only source of error in diagnosis. Certain other tumors are exceptionally observed which might be mistaken for this more serious disease. Macroglossia, angioma, and papilloma are deserving of mention only. They are too rare to be considered separately. Hard chancre

of the tongue, which is occasionally observed, might for a time simulate carcinoma, but mucous patches and secondary syphilitic tubercles, which are usually multiple, can hardly lead to error. The scars of cured secondary syphilides are very apt to become the sites of carcinoma. Theoretically there are lipomas, sarcomas, and fibromas of the tongue, but they are not surely and pathologically demonstrated. Lupus of the tongue usually accompanies lupus of the face. Tuberculosis of the tongue is only rarely seen, and then in patients suffering of general pulmonary tuberculosis. Local abrasions of the tongue from contact with bad teeth or artificial plates hardly lead to errors of diagnosis, but they seem to lead to the localization of carcinoma in the abraded spot.

The symptoms of carcinoma of the tongue which usually attract attention are the ulcer, the thickening, and the pain. The pain extends into the ear, and sometimes is recognized long before the tumor has become noticeable in the tongue itself. The pain is very sharp, severe, burning, and seems to be worse at night when the patient tries to sleep. The growth of the tumor is usually confined to one side of the tongue, and early involves the submental and cervical lymph glands. The whole floor of the mouth becomes early infiltrated with carcinomatous nodules. In the tongue itself the tumor shows as a hard, irregular, somewhat nodular mass, which is ulcerated in the middle, and if examined microscopically, it is found to consist of a flat-celled epithelial growth, with nest-like formations, somewhat similar to those found in carcinoma of the lip.

The duration of life in cases left to themselves is remarkably short. The location of the tumor, and the rapid extension of the disease to the adjoining, and by metastases to distant organs, is unusually rapid. The great majority of cases terminate within one year, while a few of them live a year and a half or two years after the disease is capable of diagnosis.

The diagnosis must be made absolute, and this can be done only by considering the age, the findings in the neck, and by the examination of a portion of the tumor excised for that purpose. The histological appearance of carcinoma of the tongue is so uniformly characteristic of an epithelial carcinoma, that a diagnosis may be made even upon the operating table by using a rapid method of hardening, staining, and cutting. Usually a sufficient bit of tissue can be removed under cocaine anesthesia to give time for a complete microscopical examination and diagnosis. Some cases go to operation in such a condition that a clinical diagnosis is almost absolute, still it must be remembered that Esmarch and the most experienced surgeons since his time have occasionally operated upon simple gumma of the tongue, and the recurrences which followed have been cured by inunctions of mercury and the administration of the iodide. The therapeutic test should always be made.

The only treatment of carcinoma of the tongue is radical removal. The results depend entirely upon the stage of growth in which the operation is performed, and the thoroughness with which the lymph glands to which the tumor is tributary are removed. The operation is a serious one, and should be undertaken as

such, and every provision should be made to prevent danger to the patient from hemorrhage.

Miculicz reports no death from operation during the last twelve years. Kocher reports a death rate of 7.1%; Volkmann had a death rate of 5.7% in his severe cases, and 2.2% in all cases. Butlin reports 9 deaths in 53 hospital cases, and 1 death in 49 private cases. Trendelenburg has lost 17 cases in which he removed half of the tongue, and 6 in which he had removed the whole tongue; 4 of these cases died during the first fourteen days after the operation.

In only a few of the earlier cases is the surgeon able to meet the classic requirements of the treatment of carcinoma. It is but rarely that he is able to remove the tumor and all the lymph tissue to which it is tributary. In all other cases in which he decides to operate he attempts the removal of the peripheral lesion to relieve the patient of the pain, and to deliver both the patient and his associates from the stench of the disorganizing neoplasm.

A great many methods of operating have been devised. By some operators the tongue is approached through the mouth. This is difficult and dangerous. By others the tongue is pulled through an opening in the neck. This gives ready access and makes hemostasis and all dissection easy. By others the symphysis of the lower jaw is divided and the greatest access is given to the mouth. The student is less interested in the method employed than in the pathology, course, and diagnosis of the disease. Whatever method is chosen, it should give the greatest freedom in operating and the most complete hemostasis; it should permit

the complete removal of the sublingual salivary glands, the lymph-containing tissues of the neck as far down as the clavicle, and it should make complete closure of the wound possible and easy.

Recurrence is extremely common. Trendelenburg had 80% recur; Billroth, 83%; in the Heidelberg clinic, 75%; in Küster's clinic, 68%; in Kocher's clinic, 75% recurred; most of these in the site of the operation, and all of them in the lymph glands of the neck. Recurrence usually shows itself from two weeks to four years after the operation, but it sometimes does not appear, as in Sachs' case, until ten or twelve years. The chance of recurrence depends upon the extent of the disease at the time of operation, and the thoroughness with which the tumor and the adjacent lymph tissues are removed. Infection of the field of operation is one of the greatest factors in establishing a recurrence. Therefore, the operation should be done under the strictest antiseptic precautions.

The use of the cautery in making the excision of the tongue is to be deprecated because of the frequent occurrence of inspiration pneumonia, due to the inhalation of the bits of eschar, and also to the almost certain infection which follows in the wound. The use of the écraseur chain should be avoided for the same reason. When operating for carcinoma, the minimum amount of traumatism should be secured.

In carcinoma of the tongue, as well as in other severe operations on the nose and mouth, a preliminary tracheotomy and the use of the Trendelenburg tracheotomy tube is sometimes absolutely necessary.

It is, however, a serious question, and must be decided by the skill of the operator and his anesthetizer and the extent of the operation to be performed.

The ideal anesthetic for this operation is chloroform, and in patients of the age during which this procedure is most frequently practiced, the severe turgidity which is produced by ether is very embarrassing to the operator, and the necessity of using concentrated vapor in operations about the mouth without tracheotomy makes ether almost impossible.

Butlin (British Med. Jour., February, 1898) gives a very gloomy picture of the result of operation for carcinoma of the tongue. In his 53 hospital cases 9 died as the result of operation; 7 were lost sight of; 8 had recurrence at the field of operation; 16 had appearance of the carcinoma in the lymph glands; 4 died, probably of carcinoma, at a later date; 2 were well three years after operation; and 7 were well more than three years after the operation. In his 49 private cases he had somewhat better results; only 1 died as the immediate result of the operation; 1 had recurrence in situ; 12 had affection of the glands in the neck; 4 died within one year; 9 were well less than three years after the operation; 13 were well or died of other causes more than three years after the operation.

Butlin always aims to remove the carcinoma with three-quarters of an inch of apparently healthy tissue surrounding it.

There seems to be a relation, of what nature it is impossible to say, existing between syphilis and carcinoma of the tongue. It has been noticed by all

authors, and was especially pointed out by Stokes. The use of the pipe and the neglect of the teeth are also important etiological factors. Syphilis not only precedes cancer of the tongue, but also simulates it. An old syphilitic ulcer of the tongue is prone to become a carcinoma, and syphilis of the tongue not only produces a tumor almost exactly resembling carcinoma, but it gives rise to an adenitis in the cervical lymph glands and the floor of the mouth which is with the most extreme difficulty differentiated from the enlargement of these structures in carcinoma.

In August, 1892, Dr. Charles H. Loder referred to me Mr. W., who was suffering of a growth on the left side of his tongue. He had been operated on twice during the preceding year, once in August and again in February, for a tumor of the tongue. In both these operations the hemorrhage was almost uncontrollable, and the growth reappeared after a few weeks.

Examination of the patient showed a man 60 years of age, with white hair and a fair skin, of active habit and a nervous temperament. He weighed about 170 pounds, and was 5 feet 6 inches in height. He had been at one time a public speaker, had raised a family of healthy children, and was now married to his second wife, by whom he had one healthy child about two years old.

The tumor had first appeared as a hard, painful mass on the surface of the tongue, directly opposite a decayed tooth. It had troubled him for three or four months prior to the first operation, and after its excision in August it quickly reappeared, invading the floor of the mouth almost from the start. The pain

became so intolerable, and his salivation so disagreeable, that he submitted to a second operation in February. Following this operation the growth returned and covered the entire ridge of the left side of the lower jaw, reaching almost to the cheek. At the time of my examination the anterior two-thirds of the tongue and the left alveolus were one continuous mass of suppurating tumor. The lymph glands of the left side of the neck were enlarged and palpable. His temperature was considerably above normal, and he was miserable through loss of sleep and lack of food. He was removed to the Presbyterian Hospital with a view to radical operative treatment. After several days' feeding with the stomach-tube, and strenuous effort to sterilize the mouth, he was prepared for operation. The procedure was carried out under chloroform anesthesia, with the assistance of Dr. McClannahan, and in the presence of Drs. Lodor, Van Hook, and Graham.

An incision was made in the middle line of the lower lip and carried downward to the sternum, and the skin of the neck and cheek was separated from the lower jaw on each side as far back as to the rami and the anterior borders of the sterno-cleido-mastoids. The resulting hemorrhage was easily controlled by ligatures. Two lower incisors were extracted, and the chain saw was used to separate the mandibula at the symphysis. The tongue was then grasped in a tenaculum forceps and the healthy left half divided from the diseased portion, as far back as the epiglottis, with strong scissors. The left half of the tongue, with the attached alveolus, was wrapped in a sponge

and held aside while the left lingual artery was brought into view, grasped by two forceps, and ligated. The fat and inclosed lymph tissues, as far back as the carotid sheath, was carefully raised with the tumor, and the entire mass separated from the epiglottis and pharynx. The chain saw was passed around the left ascending ramus of the lower jaw, and the bone cut off above the angle. The jaw, together with the right half of the tongue and attached fat and lymph tissues, was removed en masse. The right ramus was next cut off in the same fashion. An oblique incision was made through the tip of the tongue, which was then brought into opposition with the remaining remnant of the organ, and sewed to the cut surface at the epiglottis. The cheek wall was sutured to the tongue all the way round, and the mucous membrane in the middle line of the lip was joined with fine catgut continuous and interrupted stitches. In this way the whole floor of the mouth was completely closed, and the cut ends of the rami covered in. The left carotid was protected by putting a row of deep catgut stitches through the platysma and the muscles at the root of the tongue. Two one-inch incisions were made in the skin of the neck over the greater cornua of the hyoid bone, and the open spaces drained by wicks of iodoform gauze. The skin of the lip and neck was carefully closed with interrupted silk stitches.

During the week following the operation the patient was fed by means of the nasal tube. He had very little temperature and suffered no serious discomfort. At the end of three weeks he left the hospital with all wounds completely closed except the two incisions

made for drainage. From one of these Dr. Lodor removed a bit of iodoform gauze which had been lost during a dressing. Within two months the patient resumed his office work. He was able to speak intelligibly, and his deformity was concealed under a growth of beard. In the winter of 1897 he suffered an attack of pneumonia and died within a week. Up to that time, a matter of five years, he had exhibited no evidence of recurrence of the carcinoma, and during this interval his wife had given birth to two healthy children.

The apparent success of the operation in this case depended upon the complete removal of the submaxillary salivary glands, the contiguous fat, and the contained lymph tissues, as far down as these structures were accessible. The ease with which the operation was performed, and its bloodless character, was due to the liberal incision and the wide separation of the halves of the lower jaw, with the consequent enlargement of the field.

In Johnathan Hutchinson's Archives of Surgery, Vol. VII., p. 390, there is an interesting conversation on the diagnosis of carcinoma of the tongue which is significant in this connection. I will reproduce a portion of it here for the purpose of illustrating the Socratic method in Hutchinson's hands.

Q. Have you ever thought on carcinoma of the tongue, which in the end proved not to be carcinoma?

A. Yes; or, at any rate, I have known several cases to get well under constitutional treatment which I had judged to be cancer. In particular, I remember one with deep, ragged ulceration of the tongue, in which

there was an extensive implication of the lymph glands of the neck. The diagnosis lay between broken-down gumma and carcinoma, and the glands decided me Had the tongue stood alone, I should have thought it gumma. It was impossible to operate, and so I prescribed iodides, and the man got well.

Q. Would not the microscope have been of use in such a case?

A. I do not think so; in the first place, to cut out an adequate specimen would have been to excise the ulcer, and this was exactly what the patient wished to avoid. Supposing the verdict had been negative, it would have been untrustworthy, and if positive, it could not have led to a better result.

Q. Do you not think highly of the usefulness of the microscope in the diagnosis of cancer in its earliest stage?

A. I think it, on the contrary, apt to mislead and to beget false confidence. I have never in the whole course of my experience known an instance in which the microscope declared a sore to be cancerous, concerning which I had any doubts, in which the instrumental diagnosis was confirmed.

Q. In other words, you think that the naked eye appearances which justify diagnosis occur quite as early as any of which the microscope takes cognizance?

A. Just so, for I have known several cases in which negative results of microscopic examination were allowed to throw doubts on the diagnosis by the unassisted eye and finger, and in which the judgment of the latter was confirmed. In some of these very valu-

able time had been lost owing to misplaced confidence in histology.

Q. Would you, then, disuse the microscope altogether as an aid to diagnosis of cancer of the tongue?

A. Yes, excepting as a means of affording certainty to a hesitating patient or an unconvinced colleague. I would never trust its indications if they differed from the conclusion arrived at on other grounds.

Q. But surely you may leave it as a help to those who are less confident than yourself?

A. They are precisely those most likely to be misled; they had far better act upon the common-sense rule to cut out everything which is doubtful.

Q. This might do for superficial ulcers, but how when it involved a question of removing the whole tongue and the lymph glands of the neck?

A. I quite admit that you have an exception in the latter, but can scarcely imagine a case in which a week's trial with iodide of potassium would not help more than the microscope.

Q. Do you think a week of iodide long enough?

A. It ought to produce very definite results in the case of a gumma; not, of course, to cure it, but to cause unmistakable improvement.

Q. On what naked eye appearance do you most rely?

A. On a certain granular appearance of the surface like cauliflower buds on a small scale, and flattened down. This is never closely simulated by syphilis. The eye and the finger must, however, always help each other. Under these buds there must always be a disc of definite induration.

Q. But may not a gumma be hard?

A. It may be very hard in an early stage, but seldom is so when ulcerated and broken down, and besides, a gumma never shows the granulated surface.

LITERATURE

The literature of carcinoma, and especially of carcinoma of the tongue, has been collected by Robert Behla. Die Carcinomlitteratur; Eine Zusammenstellung der in—und ausländischen Krebsschriften bis, p. 244, Berlin, 1900.

Andrews. A study of the location of 7,801 primary carcinomas, Journal of the American Medical Association, Chicago, 1899.

Butlin and Spencer. Diseases of the Tongue, London, 1900, with full literature.

CHAPTER XVII

INFECTIOUS DISEASES OF THE FACE AND SCALP

Primary syphilis of the face; common sites of chancre of the face; atria and means of infection; case illustrative of chancre of the eyelid; case illustrative of chancre of the lip. Other infectious or operable diseases of the face and scalp: actinomycosis, anthrax, glanders, head tetanus, rhinoscleroma, lupus, furuncle and phlegmon, erysipelas.

On account of the danger of errors in diagnosis, it is necessary to consider separately chancre of the eyelid, of the nose, of the lip, of the tongue, and of the alveolus. While chancres in these regions are relatively rare, the vascularity of the parts involved and the progress of the disease make them very interesting, from both the surgical and the medical standpoint.

Chancre of the eyelid occurs from the use of unclean instruments, and from efforts to remove foreign bodies from the eye by means of the tongue. Chancre of the nose, lip, alveolus, and tongue occur not only from kissing and other forms of direct contact with affected persons, but as well from the use of dirty diagnostic instruments, dental tools, gags in the course of anesthetics, and even from inadequately cleaned table utensils. The most common chancre of this region is that of the lower lip, and in the majority of cases it is probably due to direct contact with a syphilitic person.

Prior to the antiseptic period chancres of the alveolus and tongue were not uncommon as a result of uncleanly dentistry. In my own practice I have observed two cases of alveolar chancre, and one of chancre of the lip which seemed to be directly traceable to infection from dental tools.

In 1896 a man visited my clinic for a tumor growing on the outer border of the left lower eyelid. This tumor was hard, red, and produced eversion of the lid. It was a centimeter long, and one-half a centimeter in breadth. The eyelashes over the tumor had dropped out, and the surrounding tissue was injected. The patient was forty-six years of age, married, and the father of a large family of healthy children. His wife was a strong healthy woman, and was at this time nursing a child but a few months old. She had never suffered any abortions. The patient was carefully examined from head to feet, but showed no evidence of disease. His temperature was about one degree above normal, but otherwise he seemed in perfect condition; no eruption could be found on his body. In getting a history of his habits and occupation no suspicion as to the nature of this tumor was aroused. The tumor had come on during the preceding two weeks, unaccompanied by pain until its increasing size interfered with motion in the lid. A placebo was given him, and he was requested to return to the clinic on a subsequent day.

His second visit was nearly a week later, and three weeks after the first appearance of the growth. The lymph glands on the side of the face below the lid, as well as the glands on the same side of the neck, were

now palpable. A fine primary syphilitic eruption showed itself on the breast and abdomen, and in the fauces. The tumor maintained the same appearance as noted at the previous examination. The temperature was now nearly two degrees above normal, and the patient felt distinctly sick. A further inquiry into the patient's immediate history developed the fact that two months previously he had followed a threshing machine in South Dakota for three or four weeks. One day while threshing barley, a barley beard had got into his left eye. It resisted all attempts at removal until one of his fellow workmen pulled down the lower lid, and swept the offending particle out with the tip of his tongue. Six weeks later the tumor, which was now proved to be a chancre, began to grow. With the establishment of the diagnosis the patient was subjected to vigorous mercurial inunctions, and the tumor disappeared with anticipated promptness.

Mr. F., 35 years old, had been an acquaintance of mine, and his family had been my patients since the time of his marriage, eleven years previously. He was a temperate, clean living man, and had a family of four healthy children; his wife was a strong, well woman.

In the summer of 1897 he consulted me for a feeling of general weakness and discomfort. I made a careful examination of him from head to feet, but could discover nothing abnormal except a slight rise of temperature and what he called a "cold sore" on the left side of his under lip. I inquired particularly into his history and habits of life during the preced-

ing six weeks, but elicited nothing to arouse my suspicion. I gave him a bitter tonic as a placebo, and enjoined care in regard to contact of the lip with members of his family, or with towels and napkins which might happen to be used by others.

During the following week I made a careful study of the office in which my patient worked. There were five other men employed there, and they used a common towel, wash basin, and drinking-cup. With the assistance of one of the clerks, who was a patient of mine, I got a good medical history of every man in the office. Only one of these was significant. A book-keeper, 32 years of age, had early in the summer lost his eyebrows, and a good deal of hair. He was a reserved, silent man, a bachelor, and he lived down town.

Within two weeks of the first observation my patient had a characteristic roseola covering the chest and abdomen, his eyebrows and hair began to fall out, and the lymph glands had appeared in every part of his body. His temperature had remained one and one-half degrees above normal, and a diagnosis of syphilis was made. He was at once given a series of mercurial inunctions, followed by mixed treatment, upon which all local and constitutional symptoms disappeared. He regained perfect health, and the diagnosis was made absolute.

Chancre may appear on any part of the face, and it has been known to develop in slight cuts received in the barber shop.

ACTINOMYCOSIS

Actinomycosis usually has its primary seat in the alveolus, but here it frequently passes unrecognized, and the first manifestation presented to the surgeon is the ulceration of the cheek or neck. The diagnosis is wholly dependent on a microscopic recognition of the fungus. Geographical distribution of this disease makes its center, so far as the United States is concerned, somewhere in central Iowa.

ANTHRAX

Next to the hand, the face is the most common site of the primary infection of anthrax. In 1,077 cases studied by William Koch, it appeared primarily in the face 300 times. In America, outside the foreign wool and hide trade, the disease is almost unknown. The pustule arises either from direct contact or from the bite of an infected fly. The pustule is surrounded by an area of excessive inflammation (malignant pustule), and the blood quickly becomes filled with the growing bacillus. Within twenty-four to forty-eight hours after infection the pustule is covered by a blister, in which large numbers of anthrax bacilli may be recognized.

The lymph glands are quickly enlarged, and form long chords of inflamed tissue. The temperature is high, and delirium and somnolence come on, and in the worst cases death follows in a few days.

The diagnosis is easy and the treatment is unsatisfactory. Any disturbance of the primary focus seems to encourage general infection.

PLATE X

Anthrax of the brow. Dr. Louis Mutschler's case, Annals of Surgery, October, 1901.

GLANDERS

Glanders is a disease occasionally acquired by those who have the care of horses and cattle. The hand is the most frequent site of primary infection, but it also appears in the nose and on the face and scalp, probably as a result of infection from the finger nails. The disease is to be recognized only by the history and a microscopical examination, and by implantation into guinea pigs, in whom it produces a characteristic orchitis. It shows a remarkable tendency to metastasis, and in one case, in which I operated more than twenty times, a number of these metastatic foci were on the scalp and face. (Jour. Am. Med. Assoc., Vol. II., 1893.)

TETANUS

Infection with the bacillus of tetanus in the scalp or face produces a series of rather characteristic symptoms that have been described by Rose, Brunner, and Klemm, under the name of head tetanus, hydrophobic tetanus, and paralytic tetanus.

The course of the disease is unusually rapid and fatal, and it is still too early to say what effect would be produced by the use of antitoxin. (Rose, Der starr Krampf des Menschen, Deutsche Chirurgie; Klemm, Die Facialis Lähmung bei dem Tetanus Hydrophobicus des Menschen. Deutsche Zeitschrift für Chirurgie, Band 32.)

RHINOSCLEROMA

Rhinoscleroma was first noticed by Hebra, in 1870. It seems to be indigenous to Austria and Russia, and is particularly rare in the United States. In 1893 Dr. Jackson could find only three cases reported, and since that time very few additional cases have been observed. Of these one is reported by Dr. Freudenthal. (N. Y. Med. Jour., Feb. 1st, 1896.)

The diagnosis is based on the location of the disease in the nose, the extraordinary ivory-like hardness of the affected part, the very slow development of the condition, its sharp contour, and the absence of edema or other inflammatory symptoms, the absence of any visible metamorphosis of the neoplasm, the ineffectiveness of any treatment, the absence of danger to the general system, and last the absence of pain in the diseased part except when it is touched.

The disease begins in the nose and very slowly extends to the pharynx, larynx, and bronchial tubes. When it reaches the larynx it greatly resembles chronic hypertrophic chorditis. The only favorable termination on record is a case reported by Lubliner. The patient suffered of undoubted rhinoscleroma, and incidentally came down with typhoid fever. At the end of this disease the tumor had almost entirely disappeared, and never returned again.

Attempts at treatment with anti-toxine have been made, but without positive result.

PLATE XI

Rhinoscleroma, from Wolkowitsch's monograph. Langenbeck's Archiv., Bd. 38.

PLATE XII

Lupus of the face. From an article by Dr. H. Stieda, in Beiträge zur klinischen Chirurgie, Bd. 15, 1895.

LUPUS

Lupus is a tuberculous infection of the skin, usually of the face, but sometimes of the mucous membranes of the mouth, pharynx, vulva, and vagina. It consists of small, scattered nodules of new-formed tissue somewhat resembling granulation tissue. These nodules are located in the cutis or in the mucosa and submucosa. The overlying skin throws off a large amount of epidermis, and in the later stages the lupus nodules are exposed and naked. It spreads slowly by the formation of new nodules or tubercles in the neighborhood of old ones. Sometimes the proliferation advances in one direction while it is being destroyed in another by the production of scar tissue. Lupus appears most frequently upon the nose, upon the side of the cheek, near the angle of the jaw, at the corner of the mouth, and in the neighborhood of the canthus. It is rarely observed on the forehead and scalp, or in the external auditory meatus.

It has received various clinical names to distinguish the grades of its manifestation. Lupus facialis, lupus vulgaris, tuberculosis cutis, tuberculosis verrucosa, and scrofuloderma are frequently met with in the literature.

Lupus facialis begins as a rule in childhood or adolescence, its greatest frequency being between the ages of ten and eighteen. In 100 cases of Von Winivarter 28 per cent were of the nose and 78 per cent of the face as a whole.

The disease shows an hereditary tendency, according to Sachs, in 85 per cent of all cases. In 276 of Bender's cases there was tuberculosis elsewhere.

Two or three red spots appear upon the cheek. These are slightly raised, but sometimes slightly depressed. They slowly change to semi-transparent, jelly-like masses. They are the true tubercles of lupus. Gradually more and more tubercles appear in the course of subsequent months or years, and then unite into an elevated mass, covered with scales of epidermis. At the border of these masses typical fresh tubercles are always to be found. The centers of these plateaus either ulcerate and become cicatricial tissue, or in other cases cicatrization occurs without ulceration and the elevation gradually sinks into a depression. As the disease advances, the skin, subcutaneous tissue and the muscles are eaten away, but the disease rarely invades the bone. When it reaches this structure it cicatrizes over and the disease progresses in some other direction. The appearance of lupus seems to be subsequent to tuberculous disease elsewhere in the body. It spreads from a tuberculous eczema about the nose or mouth, or it arises from tuberculous lymph glands in the neck, but more often the source of infection cannot be discovered at the time when the patient comes for treatment. There are undoubted cases in which the disease followed measles, or other infectious diseases. In a few instances it has been accompanied by tuberculosis elsewhere in the body resembling erythema nodosum.

The greatest surgical interest centers in the diagnosis of skin tuberculosis on account of the danger of mistaking carcinoma for it or for lupus syphiliticus.

In lupus there is a history of the disease beginning in early childhood or adolescence; in syphilis there is

usually a more or less definite history of the earlier stages of this disease; in carcinoma there is no such history, and carcinoma of the face especially, occurs only in late or middle life. Lupus shows a tendency to heal in certain parts and to progress in other directions, carcinoma never heals without treatment; syphilis heals quickly under specific treatment.

Lupus has around its borders small tubercles of the size of millet seeds; carcinoma shows hard, infiltrated masses around the borders; syphilis is hard at first (gumma), and later ulcerates and breaks down with no infiltration of the edges. In lupus the lymphatics are usually not enlarged; in carcinoma the immediate lymphatics are usually involved; in syphilis the lymphatics are enlarged over the whole body. In the absence of the small tubercular nodules a clinical diagnosis is difficult.

Carcinoma may arise in a lupus patch. Desbonnets collected 86 cases in which epithelioma occurred in the lupus or in the resulting scar. Erysipelas occasionally breaks out in a lupus and sometimes results in a cure.

An experienced physician may make a positive diagnosis in the typical cases from a clinical examination, but in a very large proportion of the cases he must resort to a microscopic and bacteriologic examination. There are many cases in which the most experienced are obliged to rely on culture methods. Little pieces of the tumor are then implanted in guinea-pigs, and if tuberculous, give very positive diagnostic data. The novice must resort to the most exhaustive methods of diagnosis in all questionable

cases. It must not be forgotten that lupus has been found associated with sarcoma. It occasionally furnishes an atrium for infection which locates in the adjoining tissues.

Such was the case of Ludwig's angina which I observed in a man aged forty-five, who had suffered from lupus of the right side of his face since boyhood. His face from the corner of the eye to the edge of the jaw was covered with deforming scars. The borders of the scars in various places showed the typical appearance of the progressive disease. After an unusually hard spell of work in his office, covering several months, he noticed that the lupus was getting worse. One night, upon returning home, he had a slight chill and felt a stiffening in his jaw. He was unable to eat his supper, but took a bath and hot drinks and went to bed. Six hours later he awoke with a feeling as of being strangled by some one, and found the root of his tongue and the floor of his mouth hard and swollen. He went into a protracted chill, which was followed by great difficulty in swallowing and dyspnea. He became delirious and maniacal. A physician who was called recognized the case as one of Ludwig's angina, with a probable primary focus in an ulcerated lupus nodule on the cheek. About five o'clock in the morning I was called to see him, and carried the paraphernalia for operating with me. The floor of the mouth was tremendously swollen and of stony hardness. The pulse was excessively rapid and the temperature was 104.5. No careful examination could be made until the patient was anesthetized with chloroform. The tongue was found raised up and

filling the roof of the mouth. The lymph glands of the neck were found enlarged on both sides, and the neck edematous. Two long incisions were made a half-inch inside the border of the lower jaw, and the capsules of the submaxillary glands were opened. The incisions came close together at the mental symphysis. The left facial artery was cut and ligated.

The wound was covered with a hot, wet dressing which was kept on with great difficulty. During the following forty-eight hours the patient's temperature fell to normal. He made a rapid recovery, followed by a most remarkable improvement in the condition of the lupus.

The prognosis of lupus is usually favorable so far as life is concerned, but unfavorable as to local recovery. There are, however, cases of lupus which seem to disappear without treatment. The unfavorable reports which appeared years ago in the literature were mostly due to errors in diagnosis. This was common enough, when the diagnosis depended entirely upon clinical features. Since skin tuberculosis is usually a local manifestation of a tuberculous infection, the patient's prospect of life is incidentally diminished by the presence of the disease.

The surgical removal of skin tuberculosis has not been very successful. It is very apt to return in a scar. Evidement and cauterization are equally unsatisfactory. In any case, even the most favorable, it is not very effective and leaves terrible scars. Various escharotics have been used with about the same success. Among these we may mention nitric acid, chrysophanic acid, zinc sulphate, and carbolic

acid. They are usually used after the fresh tubercles have been curetted, and the applications are followed by the use of ointments, salves, or antiseptic dressings. Electrolysis has also been used with indifferent success. During the past few years hypodermic injections of calomel have been recommended. Perhaps the most successful treatment so far has been daily exposures to the X-rays. The exposures are made with the Crook's tube ten inches from the skin, the rest of the face being protected by a lead mask. The exposures last fifteen to twenty minutes, and are made from one to three times a day for months at a time. Under this treatment the tubercles cicatrize and disappear, and the ugly contractions which are the result of other forms of treatment give way to soft, flexible skin. Almost equally good results have followed the exposure of the disease to the concentrated rays of the sun filtered through red or green glasses. It is, however, too early to report upon the permanence of this treatment.

Such terrible defects follow the ravages of lupus that it is sometimes necessary to operate to cover up the scars which result either from the disease or from the treatment. When this is undertaken the disease is apt to break out anew in the operation wound in spite of every effort to prevent it.

FURUNCLE AND PHLEGMON OF THE FACE

There are two reasons why phlegmon of the face must be treated with great care and promptitude. The first is the danger of infection of the contents of the cranium, and the second is the danger of deform-

ing the face and injuring the appearance of the patient. Injury of the cheek or scalp resulting in slight abrasion sometimes gives rise to extensive phlegmon. The tissues of the face are so dense and vascular that when they are infected they proliferate and thicken with great rapidity. Acne pimples with severe traumatism are prone to break through the base of the gland which contains them and produce furuncle and phlegmon in the subcutaneous connective tissue. Foreign bodies are sometimes lost in the deep connective tissue of the face in children and give rise to long-continued suppuration. As an example of the first serious consequences of furuncle of the face, I wish to refer to an unfortunate case:

Dr. Hawley called me to see a woman suffering from symptoms of meningitis. Two weeks previously she had a small furuncle half an inch below the floor of the right orbit. It grew rapidly in size, and looked ugly and red. It made the patient sick. She suffered from severe chills and vomited a number of times. Being a Christian Scientist, she refused all medical attention, and at last, when the eye had been closed by the inflammation and the alarming symptoms of meningitis, Dr. Hawley was called to see her and brought me into the case. I found a hard, indurated cheek, in the midst of which there was an abscess about an inch in diameter, directly below the floor of the orbit. The patient's temperature was 104 and her pulse very rapid; she was unconscious, the pupils were observed with difficulty, but they were certainly both dilated. The urine and feces were passed involuntarily, and her condition was such as to preclude

any careful examination. The left arm and leg were used less accurately than the right, but there was only beginning paralysis. On account of the swelling the muscles of the face could not be made out. I decided that under the circumstances opening of the cheek was alone indicated. This was done without an anesthetic, and half an ounce of bloody pus came away. The wound was filled with gauze, and the cheek kept covered with hot, dilute sublimate solution. Six hours after this operation she died, and at the postmortem a general sinus thrombosis beginning in the cavernous sinus was observed, with general pachymeningitis in the neighborhood of the sinuses.

Another very important case was one I saw in company of Dr. William L. Wilson, in 1898. The patient was a young man 24 years of age, strong and healthy; he drove a laundry wagon. One Saturday night he worked much later than usual, and felt very lame and tired on going to bed. He was inclined to attribute this to over-exertion rather than to any illness. Sunday morning he noticed a stiffness of the left side of the face near the corner of the mouth. In the center of this area was a little pimple which he scratched off with his finger nail and washed several times with Pond's extract. During Sunday afternoon he had several slight chills, and by night the whole side of his face, and even his lower lip was swollen, and very stiff and painful. Dr. Wilson first saw him on Monday morning at eleven o'clock. The temperature was then 104, the pulse hard and rapid, and the whole left side of the face and neck swollen, indurated, and too dense to be pitted. The skin was not very red, but the

tumor felt hot and was very sensitive. There was a slight cough with no expectoration, and several areas of pneumonia were found in the right lung. The little pustule on the cheek was freely incised, and an antiseptic dressing applied. The patient was given a laxative and put upon liquid diet.

The following morning I saw him with Dr. Wilson. At this time he was moribund. The left side of the face and neck was an indurated mass, levelling out the space between the shoulder and the temple. The swelling was of slightly irregular outline, and extended over the trachea, but no points of fluctuation could be felt and nowhere could it be indented. The temperature was very high, and the pulse almost unrecognizable. Several foci of lobular pneumonia were found in the right lung, but the condition of the patient precluded a very thorough study of the case. An unfavorable diagnosis was given, and he died a few hours later.

The autopsy revealed a streptococcus infection of the face and neck, thrombosis of the left jugular vein, and multiple streptococcus emboli in both lungs.

As an illustration of the ability of the tissues of the face to harbor foreign bodies, the following case is selected:

A child had for six months prior to my observation suffered from an abscess of the right cheek. Feeling of the cheek, there seemed to be a tumor an inch and a half long, extending from the parotid to the ala of the nose, and three-fourths of an inch wide. This tumor had two openings, one outward near the ala of the nose, and the other inward, just over the first molar. As the patient was a boy, I decided to make

an exploratory operation from the outside. Upon cutting into the middle of this tumor, I came upon several pieces of wood, blackened by age and infection. They were each about one and one-half inches long and seemed to be the end of a splintered stick which had run into the cheek through the mouth and given rise to an abscess opening on the ala of the nose. These foreign bodies were removed, and the wound scraped out. The recovery was prompt and complete.

ERYSIPELAS OF THE FACE AND SCALP

Outside of any recognizable injury, the face and scalp are frequently attacked by erysipelas. It is possible that in every case there is some abrasion of the skin, either about the mouth, the nose, the eyes, or the ears, through which the erysipelas germ gains entrance to the lymph spaces. Acne pimples and other retention cysts sometimes become the focus of erysipelas infection from which the disease spreads over the head and neck. It is always due to the streptococcus erysipelatous or pyogenes, and it is apt to recur from time to time where it has once shown itself. In these cases it is possible that the germ remains in the crypts of the skin and some traumatism stirs up the old infection in the injured spot causing it to spread through the surrounding tissue.

The typical history of a case of erysipelas is much like the following, which occurred in my own practice. The patient was a woman 62 years old. She was active and healthy. One morning she noticed that one side of her upper lip was swollen and that she felt indistinct pain in her back and legs. Within an hour,

and before she finished dressing, she had a distinct though not very severe chill. This lasted for twenty minutes, and was followed by nausea and a high temperature. During the next week she continued to have a temperature of 102, and often reaching 103 and 104. She was constipated, had no appetite, and could take only a small amount of nourishment. Albumen appeared in the urine early in the course of the disease. The swelling, which began on one side of the lip, extended over the side of the face, closing the eye and invading the scalp. On the fifth day the swelling began to extend over to the opposite cheek, closing the other eye and extending down onto the neck and shoulder. On the ninth day the swelling in the face had nearly subsided, and the swelling in the skin of the back and shoulder was found in three distinct places, separated by an inch or two of apparently healthy skin. The temperature had fallen to 100, and the pulse to 90 or 95. During the following week there were two or three occasions when the temperature went suddenly to 103 or 104, and small patches of skin were found to be swollen in the neighborhood of the receding disease on the chest and back. Four weeks from the beginning of the disease the temperature was normal and the skin had peeled off from the scalp and neck, but not from off the face, and the appetite had returned. During the whole course of the disease no remedies were used, except stimulants and mild antiseptic applications over the infected skin.

One of the most serious complications of erysipelas of the face is phlegmon under the scalp. This rarely occurs in the tissues of the face itself,

though sometimes seen in the deep and vascular tissues of the cheek. When the phlegmon appears it indicates a mixed infection, usually with the staphylococcus aures or albus. The greatest danger in phlegmon results from failure to recognize and open and drain it before infection is carried by the lymph stream or by thrombosis through to the interior of the skull. The natural edema of the scalp in erysipelas prevents in many cases the early recognition of the complication. If carefully watched the edema may be found to lag behind the edematous border of the erysipelas, and if it fails to disappear under a dressing of boric acid or dilute sublimate solution, it is safer to shave the head and open the scalp than to take the risk of meningitis or abscess of the brain.

Otto G. Stein (Chicago Med. Rec., November, 1899) reports an interesting case showing the origin of erysipelas and the desirability of making bacteriologic examinations as a routine practice. The patient was a man of about thirty-five years, a cutter in a tailoring establishment, in good health, except a "chronic catarrh of the head." He came under observation on the evening of March 10, 1899, when he was found lying on a couch with his clothes on, just as he had come upstairs about an hour before from his business below. He had been complaining somewhat during the day, but mostly of a neuralgic pain about the right side of the face and an occluded right nostril. His temperature was 105 F., pulse very rapid, but full and strong. He complained of severe headache and pain over the region of the right cheek-bone. He had vomited several times.

On inspection the right nares was found swollen, and of a dusky red and glazed appearance. It was filled with a fetid muco-purulent secretion. There was marked tenderness over the region of the right molar on pressure, and tapping on the second molar tooth elicited pain. An antiseptic nasal douche was given and small doses of aconite and belladonna prescribed to reduce the blood pressure. The following morning the temperature had fallen to 102.5 F., and by evening to 100.3 F. The nostril was now more patent and showed the appearance of bright yellow pus coming from under the anterior end of the middle turbinated body. The purulent discharge from the nose was more free and profuse, and there was much less pain and tenderness over the part.

A bacteriological examination of the secretions at this time demonstrated the streptococcus erysipelatous in profusion. On the third day the temperature was 100.8 F., with a pulse of 92. A small area of redness now made its appearance for the first time over the bridge of the nose, and another over the ridge of the right malar bone. By evening marked infiltration of the skin of these reddened spots, presenting a glazed appearance, was apparent. This was accompanied by stinging and painful sensations. On the fourth day the temperature was 102 F., pulse 108. The two reddened and infiltrated areas of the day before on the bridge of the nose and right cheek had now spread rapidly, so as to include the lower portion of the forehead between the eyes, the eyelids, the entire nose, and left cheek.

The eyes themselves remained free from any erys-

ipelatous involvement, but the lids were swollen so as to close both eyes to vision. The entire face was covered with a preparation consisting of glycerine in which was incorporated magnesium, talcum, bismuth, and carbolic acid. This was done to entirely exclude the air and by the hygroscopic action of the glycerine in the preparation, abstract the serous infiltration under the skin and thus relieve tension and pain. The douching of the nostrils was continued, lessening the inflammation within and consequent purulent discharge from the antrum.

During the following two days the temperature ranged between 102 and 100 F. The dressing was removed once every day, each time the parts showing a marked improvement in appearance and sensation. After removing the dressing the third time, numerous vesicles and pustules upon the inflammatory area were noticed, some of which had opened. Smears were taken from several of these, and microscopical examination showed the streptococcus erysipelatous. After the seventh day the temperature became normal and the swelling and inflammation rapidly subsided, and after the tenth day all signs of cutaneous and nasal inflammation had fully disappeared.

Another complication of erysipelas is extension to the mucosa of the nose and mouth. Here it gives rise to edema, and on the tongue to a very serious glossitis, and sometimes to a wandering pneumonia.

As a complication of wounds and surgical operations on the face and scalp, erysipelas is now very rare. In olden times it was extremely frequent after scalp wounds. Its onset was looked for on the fifth day

after the injury. Under antiseptic dressing, wounds of the face and head, as well as those of any other part of the body, are free from the dangers of erysipelas. Only once in my practice has erysipelas followed an operation on the head. This was in a case of mastoiditis and middle-ear disease occurring in a man sixty-five years of age. The erysipelas began in the auricle, which had been bathed in pus for several weeks, and extended over half the head and one side of the neck and shoulder. It lasted about two weeks, but had no effect upon the recovery of the patient, though it gave rise to grave apprehensions and was almost mistaken for infection within the skull.

Carcinoma and lupus of the face are sometimes the starting-points of erysipelas. Both diseases have been arrested or cured by the progress of erysipelas.

There is no cure for this disease, and it is probable that all applications are fruitless except in so far as they prevent secondary mixed infection. Ointments of lanolin and ichthyol have been recommended as well as hot, wet sublimate or boric acid dressing.

CHAPTER XVIII

TUMORS OF THE FACE AND SCALP

Retention cysts; moles, warts, and horns; lipoma; fibroma; hemangioma; lymphangioma; epithelioma, especially of the lip; sarcoma of the face and scalp, and of the skull.

Tumors of the face and scalp are of great interest for cosmetic reasons. They are relatively frequent. In Weber's collection of 740 tumors of all kinds requiring surgical intervention, 291, or 39%, were tumors of the face; 133 were carcinomas, 22 were sarcomas, 10 were atheromas, and the rest were of various sorts.

RETENTION CYSTS

Retention cysts are more common on the scalp than on the face. In the latter situation they appear most frequently about the eyebrow and the temple. The primary injury of the sweat gland occurs early in life from blows or falls. The secretion is retained and the enlarged gland becomes a hard, sometimes calcareous, mass. The smaller retention cysts of the nose and face, known as comedoes, are a combination of obstruction of the duct and infection of the gland. Efforts to remove them sometimes result in rupture of the cyst and the formation of an abscess, with considerable destruction of the soft, pad-like tissue beneath the skin, resulting finally in irreparable scars and deformi-

ties. Subsequent contraction in this scar tissue may give to the face a fixed, sardonic grin.

Large retention cysts on the forehead and temple are usually known as wens. They are easily removed. Care should be taken to find the obstructed duct at the beginning of the operation, and such incision should then be made as will leave the duct attached to the tumor. It is necessary to remove the cyst in its entirety, and without rupture to the cyst wall. Not infrequently, when these cysts have lain long neglected under the scalp, they produce by pressure atrophy depressions in the skull which persist after removal of the tumor. Rarely there is complete perforation of the skull, and the cyst, becoming loosened from its attachment, may pass through this opening and be lost in the cranial cavity.

MOLES, WARTS, AND HORNS

Papillomas of the skin, and warts of greater or less extent, are frequently observed on the face. They are supposed to be due to a superficial infection which is perpetuated and encouraged by the growth of the papilloma. They frequently have their origin in slight abrasions, or follow acne pustules and comedoes. In their simplest form they consist of an inverted sweat gland, the glandular elements of which undergo hypertrophy. The secretion appearing upon the surface hardens, and a wart or horn-like protrusion results. These are frequently regarded with superstition, as the harbingers of good fortune, or as something of a sacred nature to be preserved. Under some circumstances they have been made of commer-

cial value, notably in India, where such of the beggars as possess them encourage these growths until they attain to a length of several inches.

The only clinical interest we have in these warts and moles of the face, apart from their cosmetic importance, is the questionable tendency to become carcinomatous which they are said to possess. Superficial carcinomas of the skin, of small dimension and slow growth, may easily be mistaken for papillomas. Should these later exhibit true malignancy, the natural though erroneous conclusion would be they had undergone a change in character.

LIPOMA

Lipomas are rarely found on the face, except in the regions of the forehead and temple. In Grosch's collection of 685 lipomas there were 13 on the face. This gives a percentage of 1.9, considerably less than Stoll's computation in his cases, which was 5.25 per cent. When these tumors lie deep under the skin they frequently produce atrophy of subadjacent bone, and protrude into the skull, the sinuses of the nose, or into the mucous membrane of the cheek. Occasionally fatty tumors are found in the parotid region which are really offshoots from tumors of the neck. The nape of the neck and the shoulders are common seats of enormous single or multiple lipomas. Congenital lipomas, difficult to understand, are sometimes found in the parotid region, the cheek, and floor of the mouth. Other and less frequent locations are the maxillary sinuses, the orbit, and the walls of the nose.

The diagnosis of these tumors is not always easy,

operation frequently being necessary to complete the identification. They show no tendency to recur, but remnants of lipoma left behind sometimes grow slowly and give the patient the idea of recurrence. In making the diagnosis it is necessary to remember, for differential purposes, the lymphangiomas, the dermoids, the retention cysts of the skin, the chondromas of the parotid region, the cysts of the salivary glands, and the very rare fibromas appearing in the face.

FIBROMA

Fibromas of the face and neck are of rare occurrence, except such as grow from the nerve elements of the skin and are called neuro-fibromas. In this country these tumors are seldom met, and they have but little clinical interest. Theoretically they are connected with lymph- and hemangiomas, and as a matter of fact, they are usually found in association with them. When a large area of the skin of the face is involved in a fibroma, it often becomes necessary to remove the tumor by successive operations. Other and less frequent sites of fibroma are the orbits, the nasal sinuses, the tongue, and the floor of the mouth.

The diagnosis is usually made after the removal of the tumor, and there is no tendency to recurrence. When fibroma is associated with lymph- and hemangioma, the difficulties attending its removal are increased, and the fibroid nature of the tumor is forgotten in the more serious condition complicating it.

HEMANGIOMA

The face and scalp are favorite sites of hemangioma. In Trendelenburg's collection over two-thirds of all angiomas are primary in the face. Sex seems to play an important part in the appearance of the disease, more than two-thirds of all cases presenting themselves in females.

Angiomas show a tendency to locate about the angle of the mouth, the corner of the nose, and in the neighborhood of the ear and eye. It is probable that they bear some relation to the embryonal fissures of the face, and in this respect they may be considered as errors in development. According to their manifestations they have received various names: simple angioma, vascular nevus, arterial angioma, lipogenous angioma, and cavernous angioma.

The course of the disease is usually progressive, the arterial and cavernous varieties being more rapid in their growth than the others. They show some tendency to apparent metastasis, but their greatest interest is due to the danger of hemorrhage, and the deformity which they produce.

A few of the smaller tumors of this class have been known to become filled with coagulum and disappear spontaneously, but this is not the rule. When they advance into the region of the bone and nerves they produce atrophy and pain. In the progress of their growth, muscles and the fatty tissues of the face, the bones, and even the skin become atrophied, as if in the presence of an aneurism. Not infrequently large blood-vessels are ruptured as a result of pressure in an

angioma, and an enormous blood cyst appears in the surrounding tissue. This may cause occlusion of the duct of a salivary gland, and a retention cyst which complicates the tumor. Occasionally an angioma assumes a sarcomatous condition, and actually becomes a malignant tumor.

The treatment of these growths should be undertaken as early as possible, especially for cosmetic reasons. If allowed to progress, their removal is difficult and deforming. When the growth is excessive it should be completely extirpated, and the adjoining blood-vessels destroyed with the actual cautery, or by the application of escharotics. The defect should then be repaired by skin grafting, or other plastic operation.

LYMPHANGIOMA

Lymphangioma of the face is usually congenital and shows a peculiar tendency to increase with the growth of the child, and sometimes actually to take on a malignant form. This tumor has been made the subject of an extensive study which has not been very fruitful in results. In some cases the side of the face takes on an appearance of elephantiasis early in life. The lip sometimes becomes enormously thickened and enlarged, reaching at times as low as to the chest. The patient has a pronounced anemia, and sometimes a remarkable leukocytosis.

Besides congenital lymphangiomas of the face, there is the acquired elephantiasis, presenting the same histological picture and supposedly due to infection. The only pathological causes of this lymphangitis

which have yet been discovered are the streptococcus of erysipelas, and the filaria sanguinis hominis.

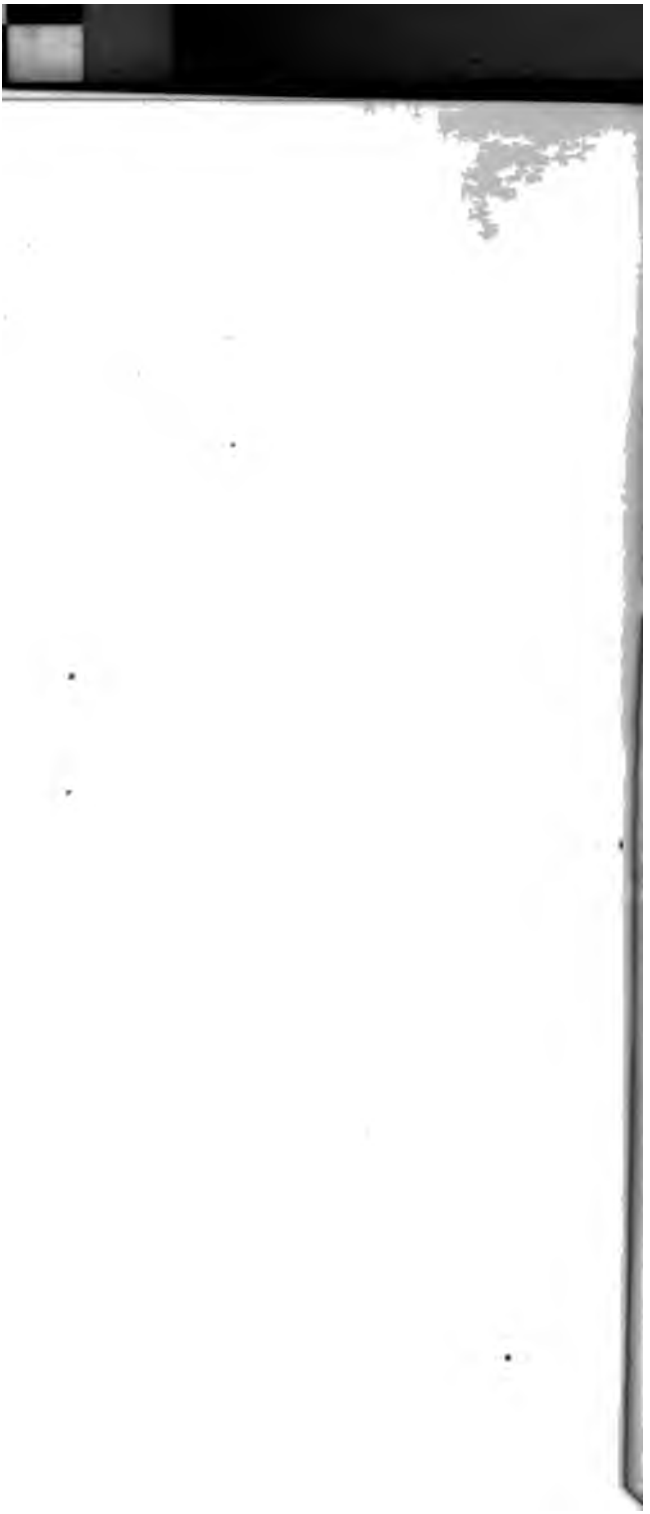
CARCINOMA

By all odds the most common tumor of the face is the flat-celled carcinoma. It elects as its site of growth the lines of junction of the mucous membrane of the eye, nose, and lip with the skin of the face. Of all neoplasms having a carcinomatous tendency, none yield so satisfactorily to surgical treatment as these so-called epitheliomas, providing this treatment is instituted before adjoining lymph tissues are invaded. On the other hand, no tumors produce such terrible consequences, nor such revolting appearances as these same epitheliomas when long neglected. Carcinoma of the face usually appears between the ages of 45 and 65, but I have a few times seen carcinoma of the lip at thirty. In one such case I made a positive microscopic diagnosis, and three months later Dr. Senn performed the radical operation. The general proposition obtains, however, that in persons of more advanced age the face is more frequently the seat of carcinoma than any other part of the body. As a case in point I may quote one which came under my observation: The patient was a man ninety-two years of age, and the epithelioma, which appeared at the left corner of his mouth, advanced in the course of five months to the extent of involving the gum and down to the lower edge of the jaw.

The etiology of carcinoma of the face is no less dark a subject than is the etiology of carcinoma elsewhere in the body. The irritation of the eyelids by

PLATE XIII

Carcinoma of the lower lip, typical and atypical form. From Regnier, Langenbeck's Archiv., Bd. 41.



ingrowing lashes, of the nose by incrustations, of the lips by pipe or cigar, or the constant picking at a mole or scab, have all been assigned, both by patient and physician, as causative factors in the growth of the tumor. Occasionally a tumor of the upper lip follows by a process of cell implantation, upon contact with an epithelioma of the lower lip. Again, carcinoma of the tongue may follow tumor of the lip, apparentiy the result of contact. Multiple carcinoma of the face is an exceedingly rare condition except in cases seemingly the result of a process of extension. Lupus and syphilitic growths, which are sometimes mistaken for carcinoma, are frequently multiple.

The course of an epithelioma of the lip when left to itself is progressive, painful, and most terribly destructive. It usually results in death in from one to five or six years, but a few cases have been recorded in which growth has advanced slowly for periods of from twenty to thirty years. The following history of a case which came under my observation early in my practice illustrates the typical course of this disease quite perfectly:

Carcinoma of the lip in a man aged thirty-five; V-shaped excision of tumor; carcinoma of cervical lymph glands three years later; ulceration of tumor of the neck, opening into the esophagus and later the larynx; ulceration of blood-vessels of the neck; repeated hemorrhages; death by hemorrhage seven years after appearance of initial lesion; autopsy.

Thomas D., aged 42, was a patient in Cook County Hospital at the time I entered upon interne service

there. He had been a constant smoker for years, and just where the pipe-stem rested, on the left side of his under lip, a small callus appeared, which had first attracted his attention when he was about thirty-five. This callus grew rapidly and became a tumor which bled considerably at intervals, and was painful at all times. He consulted a physician, who advised excision, and a V-shaped section of the lip, including the tumor, was removed The wound healed perfectly and there was never any return of the disease *in loco.* Some three years later the patient noticed certain painful swellings in the left side of his neck, under the body of the jaw. These later involved the skin and ulcerated through, and became putrid, suppurating sores, excluding him from all society. He entered Cook County Hospital in 1885.

During the following year the ulcerative process opened a passage into the esophagus, making it necessary that all food and drink be given him through a stomach-tube inserted in the side of his neck. Every effort at swallowing through the mouth was fruitless and accompanied by strangulation. During the succeeding year he had several severe hemorrhages from some of the small arteries of the neck. The larynx next became ulcerated through, and he was rendered voiceless. The pain was so great that he was given from three to six grains of morphine three times per day, and yet he suffered terribly. The stench emanating from his ulcers was so intolerable that he was of necessity given a large room to himself—the windows were constantly open, and yet the odor at his dressings was so disgusting that it became almost impossible to give

him proper treatment. The involvement of the trachea was such that he was unable to breathe except in an erect position, and during the last three months of his existence he sat bolt upright.

In the spring of 1886 he was found dead, lying in a pool of blood which came from the left common carotid artery, almost at its point of branching from the aorta. The postmortem showed the lungs, liver, and other viscera to be free from carcinoma, except by direct invasion from the mediastinum and neck. Apropos of this and other cases of a somewhat similar nature, I have observed the tendency of carcinoma, beginning as flat-celled epithelioma, to spread by direct extension, and but rarely to produce distant metastases; a condition so commonly found in the case of the adeno-carcinoma of the breast and of the pylorus.

The nearer the origin of the tumor to the surface of the skin the more likely is it to be a flat-celled, slow-growing epithelioma. The farther from the skin it originates, in the gland bearing mucous membrane, the more likely it is to be an adeno-carcinoma, and the more rapid and destructive will be its growth. The former variety of carcinoma invades the adjoining lymphatics at a very late period in its course, while to the latter variety these glands and channels, especially those in the floor of the mouth, constitute lines of least resistance, and are early and rapidly invaded by the tumor cells.

The treatment of carcinoma anywhere in the face should be early and radical excision. The operation should begin in the most centrally located and accessible lymph glands of the neck, and after their most

complete removal the incision should be extended so as to allow the removal of all tissue not absolutely vital to which the carcinoma is tributary. The skill of the operator must be directed to securing the removal of these tissues en masse, and with the least possible contamination to the wound, and in the arrest of hemorrhage and the coaptation of severed parts it must be borne in mind that the result to be desired is primary union, since recurrence of carcinoma is most frequent in suppurating wounds. In such an operation the carotid vessels, the thyroid gland, the trachea, and the root of the tongue are laid bare, and all the lymph tissue and surrounding fat is dissected out, together with the sub-maxillary glands of the affected side, the lip, and the adjoining portion of the cheek. It is only by such radical procedure that any hope of recovery can be entertained. It is needless to say that before such a serious operation is undertaken a positive microscopic demonstration of the malignancy of the tumor should be made by the operator himself.

During the past few years the X-rays have taken the place of galvanic and faradic electricity in the hands of the cancer doctors, and the success of the X-rays, and of the sunlight treatment in the case of lupus, has led to the use of these agencies in treating carcinoma of the face. The most reliable reports, however, show that the same degree of success should be attributed to the X-rays in the treatment of carcinoma as that which has been accorded during the past twenty years to such remedial agencies as pastes and hypodermic injections. It is the opinion of the most trustworthy investigators that the use of the X-rays up

PLATE XIV

Multiple sarcoma of the skull of periosteal origin with necrosis greatly resembling syphilis of the skull. Dr. Rudolph Matas' case. New Orleans Medical and Surgical Journal, May, 1889.

to the present time has not only proved insufficient in carcinoma, but absolutely dangerous. Many cases take on a renewed activity under this treatment.

SARCOMA OF THE FACE AND SCALP

Sarcoma of the face and scalp is a rare condition, of uncertain origin, and almost wholly confined to early life. It seems to be precipitated in a considerable number of cases by trauma. The anlage of the tumor is in the vascular tissues of the scalp and face, and the growth is much more rapid than in other and less vascular parts of the body. These rare tumors show a terrible malignancy and should be removed with liberal margins of healthy tissue, and as early as possible after recognition. As a prophylactic measure all moles and nevi on the scalp and face in the young should be carefully extirpated. Ulcerated sarcomas of the scalp have a number of times been observed to disappear after an attack of erysipelas.

SARCOMA OF THE SKULL

Sarcoma of the skull is a disease which usually appears as a single or multiple sub-periosteal growth. The patients who suffer from it are of all ages, and the tumors are located in almost every part of the skull. They are very difficult to diagnose from syphilitic tumors, and when they have become ulcerated, from tuberculous tumors. Like sarcoma elsewhere in the body the growth sometimes makes very slow and sometimes very rapid progress. If it arises from the diploë or medullary portion of the bone, it may show itself by signs of compression of the brain without

manifesting tumor. The early stages of sarcoma are often devoid of pain, and in this respect it is easily differentiated from syphilis. The spontaneous recovery of sarcoma of the skull has been noticed occasionally to follow an attack of erysipelas in its ulcerated surface.

Sarcoma grows also from the ethmoid and the sphenoid and the other accessory sinuses of the nose, and gives rise to symptoms which will lead to the diagnosis only when the tumor has attained considerable size and presents itself externally. From the ethmoid and base of the skull the tumor shows itself in the nose and pharynx. From the mastoid region it shows itself in the pharynx, or externally in the ear or neck. The diagnosis must be microscopical and is attended with great difficulty.

The only treatment of sarcoma is radical removal by incision through perfectly healthy tissue. This operation is always attended by difficulty and sometimes by the most terrible hemorrhage. If the tumor has completely perforated the skull, it is attached to the dura or the walls of the adjoining sinus. It pulsates with the heartbeat and the sinus must be sacrificed in its removal. Hemorrhage, air embolism, and shock are the great dangers of the operation. If the tumor has been removed with the sacrifice of a large portion of bone, the defect in the skull must be closed by the transplantation of bone from some other part of the skull. This is accomplished by cutting off the external plate of the skull from the internal or vitreous, and bringing it over the defect, together with the attached periosteum and scalp.

CHAPTER XIX

SURGICAL DISEASES OF THE ORBIT

Abscess of the orbit. Tumors of the orbit. Literature.

ABSCESS OF THE ORBIT

Abscess of the orbit usually occurs from direct infection, such as puncture with a sharp instrument or the extension of infection from adjoining tissues. We have already noticed the appearance of abscess of the orbit secondary to disease of the frontal sinuses, and in like manner it may arise from rupture of the wall of the antrum or of the ethmoidal sinuses in suppurative diseases of these cavities. In the course of intracranial suppuration a septic thrombus in the cavernous sinus is very apt to open into the orbit.

The history of the case will frequently suggest the origin of the suppuration, and suitable treatment can be instituted. If due to an injury of the lid the possibility of foreign bodies in the orbit should always be considered. In children, and even in adults, the orbit conceals foreign bodies of relatively enormous size, and their detection is frequently very difficult. If the infection springs from one of the sinuses of the head, nothing will avail but the removal of the primary cause. This subject has been considered elsewhere.

The most serious form of abscess in the orbit is that arising from intracranial suppuration. In cases

of orbital abscess from such cause a cure is of course utterly hopeless unless the primary site of disease can be reached. A mere opening of the orbit is a fruitless procedure. The following case from Macewen is significant and not without interest in this connection:

MACEWEN (l. c., p. 253). *Infective thrombosis of cavernous sinus following a pustule on the nose; first observation four days after onset; duration of illness six days. Death. No autopsy.*

Mrs. D., twenty-eight years of age, first consulted a physician on the fourth day of her illness. She had had a chilly sensation while out shopping. The following night an itching in her nose, which constantly increased in irritability, resulted in the formation of a pustule on the inside of the left ala. She was able to be about the next day, but on the fourth day the pustule required opening, and on the fifth day an abscess appeared near the canthus of the left eye. This was opened and a small amount of pus evacuated. The left eyeball was protruded, and an ophthalmologist who was called in advised consulting a surgeon. On the sixth day she was insensible and passed urine involuntarily. The forehead and both eyelids were discolored and edematous. The left eyeball was greatly protruded, and the muscles of the globe were paralyzed, giving it a fixed stare; the opposite eye occasionally moved. The pupil of the left eye was dilated and immobile; the conjunctiva of the globe was chemosed. Her pulse was rapid and feeble, and she had a temperature of 104. The pustule on the left ala had a hardened base, whitish around the

periphery, and was dark in the center. A diagnosis of infective thrombosis of the cavernous sinus arising from the pustule in the left nostril was made. The infection had reached the orbit through the nasal duct or the veins surrounding it; thence through the superior ophthalmic vein into the cavernous sinus.

In the hope of relieving the patient Dr. Macewen removed the left eyeball with the infected vessels and the surrounding tissues of the orbit. There was very little hemorrhage—probably on account of complete thrombosis. The patient was insensible to pain and the operation was performed without an anesthetic. The temperature gradually increased to 106, she had a profuse diarrhea, an almost imperceptible pulse, and death occurred, without a return to consciousness, a few hours after the operation. No postmortem was permitted.

A consideration of this case, together with the anatomy of the orbit and its proximity to the base of the brain, will enable one to realize somewhat of the dangers attendant upon infection within the orbit. It is always a serious menace to the integrity of the eyeball, and it is likewise dangerous to the life of the patient through meningitis or sinus thrombosis.

TUMOR OF THE ORBIT

The orbit is occasionally an apparent site for tumors of both malignant and benign tendencies. In the ophthalmic records of the University of Amsterdam, Blaauw found histories of only 25 cases of tumor of the orbit in the 107,201 patients treated in that clinic during twenty-four years. This would give an average

of one orbital tumor to every 4,288 patients. Taken as they come, the larger number of orbital tumors are of the malignant type, and experience has shown that operations upon malignant tumors of the orbit are unproductive of good results.

Tumors of the orbit are recognized by the pain they produce, by the resulting displacement of the globe of the eye, especially by exopthalmus, by the double vision which frequently appears before the displacement of the globe is recognized, and by the loss of motion in the globe. Later, of course, the tumor may be palpated; rarely it may show itself without any pain or displacement of the globe.

Lipomas, retention cysts of the tear glands, and malignant neoplasms of the orbital tissues are almost the only tumors showing themselves in the orbit which have their matrix there. Dermoids of the orbit arise, as do most of the other tumors, from the adjoining tissues and sinuses. If aneurisms are to be considered as tumors, aneurisms of the orbit are rarely primary in the orbit itself. Neuromas appear both in the nasal and infraorbital nerves, and grow into the orbit. This latter condition is well illustrated in the following case which came under my own observation:

Slow growing, painful tumor of the right orbit in a man 35 years of age; coincident abscess of the corresponding antrum; eneucleation of tumor after fourteen years of growth; recovery.

I saw the patient at Dr. Colci's clinic in Florence, in May of 1900. He was an Italian, about five feet four inches in height, spare in body, with a sallow skin

and yellow conjunctiva, due possibly to the use of morphine, which he took to relieve the intolerable pain caused by a spherical tumor growing from the under side of the orbit, and hanging forward on the cheek. This tumor was about 8 cm. in diameter. Its under portion was covered by the enormously distended lower eyelid. Its upper portion was bare and slightly ulcerated, and when he presented himself at the clinic, was covered with foul-smelling scabs. The globe of the eye was pressed flat against the orbital wall, and was slightly protruded, being covered by the somewhat extended upper lid.

The tumor was hard, of an almost glistening white color, did not pulsate nor fluctuate, and was apparently composed of fibrous tissue. The patient had first noticed the tumor, distending the lower lid, and elevating and protruding the eye, fourteen years previously. Its growth had been slow, steady, and painful. He had begun the use of morphine shortly after the initial appearance of the growth. The location and character of the tumor suggested the possibility of a neuro-fibroma growing from the orbital portion of the infraorbital nerve, or a tumor arising from the antrum of Highmore.

The patient was placed, wholly nude, upon a simple, metallic table with a fixed top, and his wrists and ankles firmly tied to the table with strips of sterile gauze. The chloroform was administered on an Esmarch mask, and required but a few minutes. Apart from the regular anesthetizer, Dr. Colci had two assistants: one cared for the needles and the twisted Florentine silk only, while the other handled

the instruments and assisted directly at the operation. When the patient was anesthetized the face and lid were scrubbed with soap and water, the eyebrows and lashes removed, and all made as clean as possible.

An incision was made through the lower lid and the cheek as far down as the middle of the canine fossa. The index-finger was slipped under the pedicle of the tumor, which arose from the posterior part of the orbit, and apparently from below it. The anterior

90. An osteoma of the orbit, growing out from the ethmoid bone, displacing the eye; from Berger and Tyrman.

wall of the antrum of Highmore was opened with a chisel, and was found to contain a mass of suppurating polypi and granulation tissue. Exploration with the finger discovered the fact that the pedicle of the tumor was above and behind the antrum. The excessive hemorrhage at this stage was arrested only after iodoform gauze tamponade of the antral cavity. The pedicle of the tumor was loosened from its attachments as much as possible, and grasped by a pair of artery forceps thrust back into the spheno-maxillary fossa. The tumor was then removed. The orbit had been enormously enlarged by the pressure of the growing tumor, and the eyeball flattened past recognition

against its bony roof. Dr. Colci decided to remove the globe and drain the orbit through the lower portion of the incision; this was easily accomplished. The incision in the lower lid was closed after removing a considerable portion of the hypertrophied tissue; the orbital cavity and the antrum were packed with iodoform gauze, and a large antiseptic dressing applied.

I saw the patient a few days afterward, and healing was as perfect as could be expected. All local pain had disappeared, but he was suffering the torments incident to treatment for the morphine habit.

Microscopic examination of the tumor showed it to be a neurofibroma. Its point of origin was probably in the root of the infraorbital nerve.

The greater number of sarcomas appearing in the orbit or in the nose, naso-pharynx, and orbit, arise from the ethmoidal, sphenoidal, or frontal sinuses. They usually appear in the first two years of life, but sometimes as late as the fourth. The first symptom is hemorrhage from the nose, a protrusion of the nasal bones into the orbit, or a unilateral or bilateral exophthalmus. The veins of the face soon show some enlargement, and as the tumor progresses, the pharynx is filled, deglutition, and at last respiration are impeded, and a tracheotomy becomes imperative. Then the surgeon must decide whether or not he will attempt a radical operation. Should this operation be undertaken, nothing short of the complete removal of the bony wall of the sinuses should be considered. This requires an extensive resection of the half of the face, and presents elements of the gravest nature. Nearly all efforts at cure are fruitless. The tumor

returns, and the same desperate efforts must be made again and again until the unfortunate patient dies of a grateful metastasis.

OSTEOMA OF THE NASAL SINUSES

There are a few peculiar bone tumors found in the ethmoid, frontal and sphenoidal sinuses, and the cavity of the nose, which were first noticed by Spencer Watson, in 1868. They grow from the walls of these sinuses, and sometimes attain a flinty hardness and become actually detached from the base on which their pedicle grows, and are found detached and loose. Their growth is slow and presses outward the wall of the sinus and sometimes greatly displaces the eye or the nose. The tumors rarely become malignant, and are then known as sarcomas of the region. They are removed with the greatest difficulty, in many cases breaking away the base of the skull; they are of such hardness that no chisel has been able to touch them. Twenty-five cases were reported by Berger and Tyrman in 1886 and since that time a number of cases have been reported by Fenger (Jour. Am. Med. Assn., August 11, 1888), and other authors.

LITERATURE

Witzheller. Ueber einen Fall von spongiösem Osteom der Stirnbeinhöle. Thesis Geifswald, 1900.

Zimmermann. Ein Osteom des Sinus frontalis (20 cases) Deutsche Zeitschrift für Chirurgie, Bd. 57, 1900.

INDEX OF NAMES

Agnew, 71.
Ahlfeld, 45.
Albert, 460.
Allen, 23.
Allport, 279, 441, 442.
Andral, 63.
Andrews, 482, 511.
Arnold, 347.
Ball, 289.
Ballantyne, 22, 45.
Bardeleben, 206, 262, 335.
Barker, 289.
Barratt, 405.
Bechtol, 463.
Beck, 361.
Behla, 511.
Bell, 143.
Bender, 519.
Berger, 553.
Bergmann, von, 46, 117, 149, 205, 219, 290, 301, 335, 360, 396, 401, 406, 417.
Bernard, 459.
Billroth, 503.
Blaauw, 549.
Blaschek, 136.
Bond, 45.
Bower, 74.
Brinton, 62.
Bromner, 428.
Brophy, 23, 24, 27, 29, 481.
Bruce, 37, 41.
Bruns, von, 15, 21, 22.
Bryan, 456.
Budd, 497.
Bullard, 405.
Buller, 381.
Burnett, 266.
Butlin, 504, 511.
Briggs, 185
Braun, 398, 401.
Broca, 151
Brower, 365.
Brunner, 517.
Cale, 409.
Carpenter, 29.
Ceci 403.
Chassaignac, 141.
Chaurel, 290.
Cheyne, 41.
Church, 355, 361, 364, 416.
Clark, 312.
Colci, 550, 551, 553.
Coste, 13.
Crile, 149.
Czerny, 10, 38, 41.
Dana, 42.
Dauchez, 406.
Davis, 411.
Despagnet, 125.
Deaver, 77.
Dehler, 42.
Delvoie, 217.
Denker, 424.
Dennis, 428.
De Paoli, 467.
Desbonnets, 521.
DeVilbis, 190, 305, 400, 483.
Dickson, 412.
Diebenbach, 22.
Dodge, 144.
Douglas, 394.
Duponchell, 406.
Duverney, 71.
Eberth, 496.
Eccheverria, 397, 401.
Edmonds, 351, 454.
Edwards, 322, 323.
Eisendrath, 9.
Elsner, 34.
Erbse, 497.
Eskridge, 235, 301.

Esmarch, 501.
Faucett, 36.
Feltz, 498.
Fenger, 9, 10, 11, 45, 96, 120, 121, 122, 554.
Fenn, 45.
Féré, 45.
Ferguson, 24.
Fillebrswen, 45.
Forbes, 45.
Forgue, 27.
Frank, 6, 416, 452, 468.
Frasier, 264.
Friedländer, 308.
Galloway, 192, 323, 436.
Gengmer, 205.
Gerlach, 256, 459
Gibbs, 3.
Goldsmith, 406
Gordon, 37.
Gould, 42, 140, 153, 334, 401.
Gowers, 211, 289, 298, 299, 303, 354.
Graf, 398, 401.
Gräfe, 20.
Graham, 506.
Gramm, 455.
Grosch, 536.
Gross, 42.
Grunert, 290.
Guber, 45.
Gull, 280.
Gunn, 387.
Gurlt, 77.
Hahn, 497.
Hale, 195.
Hall, 419.
Halstead, 485
Hamilton, 77, 149, 153, 335, 347.
Hanau, 497.
Hardie, 283, 320, 436, 441.
Hartley, 482
Hartmann, 470, 471
Haven, 373.
Hawley, 525.
Hays, 407.
Hebra, 518.
Heidenhain, 42.
Heister, 133.
Hektoen, 99, 119, 312.
Heller, 40.
Henle, 131.
Henoch, 35.
Herrick, 317, 321, 364.
Herter, 406.
Hessler, 306
Hewitt, 131, 132, 133, 134, 135, 136, 139.
Hildebrand, 46.
Hilton, 141, 142.
Hinde, 270.
Hirsch, 334.
Hitchcock, 106.
Hitschmann, 42.
Hitz, 301.
Houel, 3.
Horsley, 151, 358, 417.
Hotchkiss, 200, 201.
Hughlings-Jackson, 401.
Hutchinson, 41, 117, 508.
Ingals, 452.
Isreal, 496.
Jackson, see Hughlings-Jackson.
Jackson, 518.
Jacobson, 335
Jansen, 290, 307.
Jones, 267.
Kader, 45.
Keen, 7 8, 9, 46, 358.
Keown, 61.
Kernan, 407.
Kirmisson 5, 44, 45, 46.
Kitterman, 448, 449.
Klebs, 346, 347, 496.
Klemm, 517.
Klemperer, 498.
Knapp, 350, 354.
Koch 516.
Kocher, 502, 503.
Köhler, 206.
Kolle, 42.
König, 21.
Körner, 290.
Kraske, 496.
Krause, 473, 482, 485.
Krishaber, 289.
Krönlein, 173, 189, 200.

Kubassoff, 495, 496.
Kuh, 358, 365, 375.
Kunz, 453.
Küster, 503.
La Fort, 117.
Lane, 365.
Lannelongue, 470, 471.
Lanphear, 414.
Laplace, 99, 109.
Larger, 46.
Larrey, 53.
Laslett, 496.
Lawford, 351.
Lazorte, 303.
Ledderhose, 182, 358.
Lehmann, 303.
Lemke, 355.
Lichtenberg, 9.
Lodor, 505, 506, 508.
Lubliner, 518.
Lucas, 287.
Lysenkoff, 11.
Mac Ewen, 93, 117, 149, 214, 219, 276, 324, 331, 548, 549.
Mackie, 46.
Maclaren, 394.
Malgaigne, 21, 71.
Marchand, 173.
Marcy, 25.
Marks, 46.
Martius, 299.
Mason, 180.
Mastin, 95.
Matas, 71, 73, 76, 77.
May, 496.
McClannahan, 506.
McCurdy, 46.
Meckel, 14, 64.
Meriwether, 46.
Meyer, 9, 289.
Michaux, 404, 405, 406.
Miculicz, 502.
Mills, 153.
Mitchell, 347.
Monro, 34, 37.
Monroe, 405, 406.
Mosher, 456.
Moxon, 497.
Müller, 497.
Myers, 412.
Nammack, 376.
Nasse, 16, 45.
Nélaton, 21.
Newfeld, 2.
Nichols, 381, 390.
Northrup, 402, 406.
O'Carroll, 37.
Oppenheim, 335, 354.
Osler, 402, 406.
Otto, 417.
Owings, 104.
Packard 246.
Paget, 160.
Park, 195, 399.
Pasteur, 487.
Patrick 341, 364, 368, 371, 372.
Petrina, 347.
Pfaundler, 46.
Phelps, 149.
Pitt, 207, 289, 290.
Plummer, 173, 200.
Posner, 149.
Posterner, 153.
Pott, 87.
Pye-Smith, 36.
Quain, 334.
Quincke, 36.
Quinsey, 209.
Raczyanski, 41.
Raycroft. 192.
Raynaud, 34.
Reclus, 27.
Reich, 351.
Richardson, 62.
Rose, 25, 298, 517.
Rutter, 397, 401.
Sachs, 503, 519.
Sajous, 149, 153, 334
Santorini, 137.
Schaeffer, 56.
Schäfer, 151, 152.
Schimmelbusch. 497.
Schläger, 408.
Schleich, 281.
Schmidt, 149, 334.
Schoenthal, 365.

Schuster, 416.
Schwartz, 335.
Scudder, 102.
Sefton, 175.
Seguin, 170.
Seitz, 35.
Senn, 369, 540.
Siebenmann 257, 258, 261, 262.
Siemon, 346.
Simpson, 77.
Sloan, 46.
Smith, P. R., 110.
Smith, S. Macewen, 244.
Southerland, 41.
Spencer, 46, 511.
Spring, 46.
Starr, 289, 337, 338, 339, 340, 391, 398.
Stein, 46, 530.
Steiner, 173, 189, 200.
Stenson, 67.
Sterling, 386.
Stewart, 379, 385.
Stieda, 12, 46.
Stiles, 37, 41.
Stimson, 206.
Stoll, 536.
Stromeyer, 117.
Strümpell, 210.
Sullivan, 35.
Sutton, 289.
Tait, 23.
Teschan, 461.
Teutleben, 256.
Thomas, 46.
Thompson, 46 347.
Tiersch, 69.
Tillaux, 10.
Tillman, 6.
Treitel, 207 289.
Trelat, 3.
Trendelenburg, 502, 503, 538.
Tyrman, 553.
Vanderveer, 45
Van Geison, 401.
Van Hook, 316, 317, 318, 506.
Van Ness, 139, 140.
Verity, 232, 234, 454.
Viborg, 459.
Vines, 3.
Virchow 149, 153, 334, 402, 487, 495
Volkmann, 502.
Von Schraeder, 139.
Von Winivarter, 519.
Vrolik, 2.
Wallman, 5.
Walsham, 394.
Washburn, 365.
Watson, 553.
Weaver, 365.
Weber, 534.
Wehr, 497.
Weigert, 348.
Wharton, 205.
Whippern, 431.
Wilde, 265, 276.
Wilder, 351
Williams, 496.
Wilms, 298.
Wilson, 526, 527.
Winckel, 3.
Witzheller, 554.
Witzel, 45.
Wolff, 407.
Wood, 354.
Wyss, 39.
Zaaijer, 46.
Zahn, 496.
Zappert, 42.
Ziegler, 149
Zimmermann, 554.

SUBJECT INDEX

Abscess, brain, 207, 208, 209, 217, 218, 246.
absorption of pus, 213.
acute traumatic, 210, 211, 216, 217, 219.
age and distribution, 207.
chronic, 235
encapsulated, 219.
initial period, 231.
second stage, 232.
terminal period 232.
traumatic 218.
traumatic, diagnosis, 229.
diagnosis, 216.
etiology, 210.
frequency, 291.
idiopathic, 291.
mistaken for malaria, 330.
mistaken for syphilis, 330.
mistaken for typhoid, 330.
mistaken for uremia, 330.
nasal empyema, 424.
otic origin, 238, 289, 290, 298.
diagnosis, 298, 299.
differentiation, 300, 329.
frequency, 290, 291.
meningitis, 290, 291.
proper position, 304.
pyemia, 290.
sinus thrombosis, 290, 293.
solitary, 304.
parietal lobe, 214.
pneumococcus, 210.
spontaneous recovery, 213.
subperiosteal, 252, 269.
suppurative mastoid, 290.
suppurative middle ear, 290.
symptoms, 217, 291, 292, 293, 295, 296.
termination, 207.
three stages, 291.
Abscess, vomiting and nausea, 292.
extradural, 309, 330.
addages, 309, 334.
illustrations, 309.
literature, 309.
origin, 309.
symptoms, 309.
Abscess, antrum of Highmore, 428.
cerebellar, operation, 306.
orbital, 547.
case of, 548.
etiology, 547
statistics, 549.
paramastoid, guarded prognosis, 276.
simple incision, 276.
Accessory sinuses of nose, 423.
antrum of Highmore, 423.
ethmoidal, 449.
frontal, 437.
literature, 456.
osteoma, 553.
sphenoidal, 446.
tuberculosis, 452.
Actinomycosis, 516.
diagnosis, 516.
in brain, 209, 348.
sites of infection, 516.
Adages, see maxims, 58.
Adenoids, nasopharyngeal, 238.
backward pupils, 239.
children, 239, 240.
growth, 240.
post nasal, 241
treatment, 240, 241.
Adenoma, hypophysis cerebri, 347.
Adrenal, 38.
Air embolism 282.
Alcoholism, profound, 147.
pachymeningitis, 402.
Amniotic bands, 14.

Anemia, 61.
brain tumor, 364.
cortical, 124.
Anesthetic, 19.
Angioma, 43.
Hemangioma, 538.
in tongue, 499.
lymphangioma, 539.
with fibroma, 537.
Angiosarcoma, perithelial of pituitary body, 379.
Anorexia, 217.
Anisocoria, 152.
Anthrax, 516.
Antrum of Highmore, 247, 423.
abscess in, 428.
treatment, 429, 430.
anatomy, 247.
cholesteatoma, 279.
operation and instruments 284.
suppuration, 280.
topography, 284.
mastoid, 259.
see accessory sinuses, 423.
Aphasia, 151, 184, 196, 217.
after injury, 170.
brain tumor, 367.
complete, 361.
motor, due to small cortical hemorrhage, 201.
Apoplexy, 158.
brain tumor, 364.
Aqueduct of Sylvius, 36.
Artery, cerebral, 81.
hemorrhage of, 81.
meningeal, 81, 134, 153, 173.
hemorrhage of, 81.
middle meningeal, rupture, 88, 167, 173, 177, 180, 183.
complications, 198
treatment, 187.
Aspergillus, 244 245.
Autointoxication, neuralgia, 475.
Bacillus, colon, 35.
of Friedlander, 308.
Bath, cold, 240.
Bedbugs, ear, 246.
Blood, blue, 240.
Blood, effused, 59.
removed by incision, 59
Boils, external auditory meatus, 243, 244.
neglected, 244.
tympanum, ruptured 244.
Bone flap, 6.
Bone plate, decalcified, 8
Brain abscess, 207, 208, 209, 218, 235 246, 291.
absorption of pus, 213.
actinomycosis, 209, 348.
acute traumatic, 210, 216, 217.
age, distribution, 207.
chronic traumatic, 218.
diagnosis, 229.
diagnosis, 216, 298, 299.
differentiated, 300, 329.
etiology, 210.
foreign bodies, 217.
initial periods, 231.
idiopathic, 291.
otic origin, 238, 289, 290, 298.
suppurative mastoid, 290.
frequency, 290, 291.
symptoms, 291, 293, 295, 296.
proper position, 304.
second stage, 232.
sinus thrombosis, 290, 293.
solitary, 304.
spontaneous recovery, 213.
symptoms, 217.
terminal period, 232.
termination. 297.
three stages, 291.
treatment, 217.
vomiting and nausea, 292.
Brain, actinomycosis, 209, 348.
Brain, compression, 84, 167, 173, 185.
symptoms, 185.
from hemorrhage of dural sinuses, 203.
Brain, concussion, 59, 85, 161, 162.
complications, 161.
symptoms, 161.
Brain, contusion, 164, 165, 167, 200.
Brain, gunshot wounds, 217.
Brain, injury, 112, 203, 253.

Brain, laceration, 125, 150, 164, 199.
Brain, disease, symptoms, 217.
Brain, tumor:
carcinomatous, 337, 345.
cerebral, 336.
child and adult, 336.
cystic, 337, 345.
diagnosis, 361.
diagnosis, differential, 363, 364.
duration, 375.
epilepsy, 393.
etiology, 348.
gliomatous, 337
gliosarcomatous, 337.
localization, 359.
location, 336, 338, 340, 347.
sarcomatous, 337.
subtentorial, 37.
symptoms, 349, 351, 357, 358.
syphilitic, 337, 345, 348.
trauma, 349.
treatment, 341.
tuberculous, 337, 345.
Broca's convolution, 151
Bronchitis, capillary, 21.
nasal sinuses, 424.
Burns of face, 69.
Cancer, see carcinoma, 486.
Caput, succedaneum, 5.
Carcinoma, of face, 540.
case of, 541.
common sites, 540.
etiology, 540.
general considerations, 486.
relative to erysipelas, 533.
relative to lupus, 521.
treatment, 543.
use of X-Rays, 544.
Carcinoma of tongue, 486, 492, 499.
course of development, 498.
diagnosis, 501.
differential diagnosis, 499, 500
duration of life, 499, 501.
etiology, 493, 494, 495, 496, 497, 498.
hereditary transmisson, 498.
operations, 502.
relation to syphilis and tuberculosis, 493, 498, 504.
Carcinoma of tongue, recurrence, 503.
specific organism, 498.
symptoms, 500.
tendencies to, 493
treatment, 501.
vital statistics, 488, 489, 490, 491, 492.
Cartilages of nose and dislocation, 70.
Cautery, actual, in epilepsy 394.
Cavernous groove, 134.
Cellulæ tubariæ infection, 283.
Cephalhematoma, 60, 61.
with general cerebral hemorrhage, 62.
Cephalic cry, 267.
Cephalocele, 2.
mistaken for bag of waters 8.
pharyngeal, 9.
prognosis, 11.
Cerebellar ataxia, 358.
Cerebellar abscess, 306.
complications, 306.
operation, 306.
tumor, 337, 340
Cerebral localization, 150.
abscess, traumatic, 219.
diagnosis, 300.
concussion, 150.
hemorrhage, 336.
tumor, 336, 337.
Cerebration, retarded, 294.
Cerebro-spinal fluid, 287.
Cerebro-spinal meningitis, 417.
Cerebrum:
abscess, 99.
cyst in middle lobe, 37.
Chancre:
of alveolus, 512.
of eyelid, 512, 513.
of lip, 512, 514.
of nose, 512.
of tongue, 500, 512.
result of unclean dentistry. 513.
Cheek, hematoma and foreign bodies, 65.
Chills, 292, 296.
Chloroform, 19, 25.
Choked disc, 183, 351.

Cholesteatoma:
antral, 279.
cerebral, 347.
from hydatid cyst, 347.
Chondroma intracranial, 346.
Cleft palate, 13.
among aborigenes, 23.
complete, 19.
congenital, 18.
lateral, 18.
operation, 19, 26.
partial, 19.
psychosis, 28.
transmission, hereditary, 23.
Coaptation of wounds of scalp, 55.
Compression of brain, 84, 196, 203, 253.
diagnosis, 87, 172.
from ruptured middle meningeal artery, 196.
from hemorrhage of dural sinuses, 203.
symptoms, 192.
Coma:
after cranial injury, 171.
diabetic, 158.
epileptic, 158, 159.
uremic, 159.
Commotio, cerebri, 157.
Concussion of brain, 59, 85, 157, 161, 162, 196.
Constipation in abscess of brain, 295.
Contractures of mouth, 69.
Contusion of brain, 200.
Convulsions, clonic, 202.
in brain tumor, 357.
Cranial nerves, injury of, 119, 129.
Cranial cavity, opened, 282.
Cry, cephalic, 267.
Cutis anserinæ, 292.
Cyst, hydatid, 347.
Cyst of lachrymal gland, 550.
Cyst due to retention, 458, 534.
Cyst of parotid, 458.
Delirium tremens, epilepsy, 403.
Dementia, sarcoma, 355.
Dermoids, 43.
of orbit, 550.
Destroyed function of center, 151.
Development, arrest of, 1.
DeVilbis, instrument, 190, 305.
Diabetes, brain tumor, 364.
Discharge, nose and ear, 145.
Dizziness in brain tumor, 357.
Dog nose, 16.
Drainage:
in scalp wounds, 55.
through and through, 58.
into pharynx, 328.
Drunkards, scalp wounds, 54.
Dural hemorrhage, 84.
Dural attachments, 181.
Ear:
amputated, 67.
bedbugs, 246.
bloody discharge, 246.
brain tumor, 365.
dead bone, 291.
diffuse inflammation, 244.
drum, incision, 266.
drum, rupture, treatment, 269.
external, examination, 263.
foreign bodies, 245.
furunculosis, 243.
granulations, 291.
incised wounds, 67.
irrigation, 270.
Ear, middle:
anatomy, 247, 355.
disease, 307.
causes, 238, 245
frequency, 248
let alone, 275.
symptoms, 352.
fracture, 199.
polypi, 291.
sigmoid sinus thrombosis, 307.
suppuration, treatment, 279.
radical operation, 279.
Ear:
pieces of, 67.
Earache, conservative treatment, 270
Eczema of meatus, 245.
Edema, of lung, 86.
of glottis, 199.
Embolism, pyogenic, 290.
air, 282.

Emphysema, in fracture, 63, 190.
Empyema, nasal sinuses, 423, 434.
Encapsulated abscess, 219.
Encephalitis, slow pulse, 294.
Encephalocele, 2.
Endothelioma, pituitary body, 385.
Epilepsy, 393.
  after traumatism 171.
  brain tumor, 365.
  congenital, 397.
  diagnosis, 147.
  depressed fractures, 397.
  following injury, 396-397.
  following suppurating wounds, 395.
  instrumental delivery, 397.
  Jacksonian, in brain tumor 360 394.
  literature, 401.
  origin of, 395.
  poisonous remedies in, 393.
  scar formation in, 395
  statistics, 396.
  thymus gland, 397.
  traumatic varieties, 398.
Epileptics, scalp wounds, 54.
Erysipelas, 528.
  complications, 529, 532.
  etiology, 528.
  carcinoma, 533
  lupus, 68, 521, 533.
  treatment, 533.
  with phlegmon, 529.
Ethmoid fracture, 146.
Ethmoid sinus disease, 449, 451.
Eustachian tube, 247, 257
Eyes, separation, 10, 16.
Eyeball, pain, in frontal sinus disease, 440.
Eyelid, in incised wounds, 67.
Exophthalmus, 35, 125.
Extradural abscess, 330.
Face:
  burns, 69.
  injuries, 64.
  wounds, 66.
  typhoid, 213.
Fallopian canal, 282.
Fibroma:
  brain, 346.
Fibroma, face and neck, 537.
  with angioma, 537.
Fissure, of face, 14.
  of nose, 16.
Fissure of Rolando, 153, 155.
  of Sylvius, 153, 156.
Fontanelles, persistent, 12.
Foramen lacerum anterius, 134.
Forehead, tumor, 60.
Foreign bodies, 217, 245.
  in ear, 245, 246.
Fracture of base of skull, 118, 147, 199.
Fracture of skull, 47, 79, 196.
  complications, 79, 83, 102, 113.
Fracture of vault, 88, 92, 113, 146, 172.
Fracture of sphenoid, 133.
Fracture, with epilepsy, 397.
  with concussion, 163.
  with pachymeningitis, 403.
  with insanity, 408.
Fracture of zygoma, 71, 72, 75.
Frontal bone, fracture, 82.
Frontal sinus, 437.
  anatomy, 438.
  disease, 438.
  examination, 440.
Furunculosis of ear, 243.
  of face, 524.
Gangrene:
  acute emphysematous, 63, 68.
Gastritis, nasal sinus disease, 424.
Gasserian ganglion, 482.
Gastro-enteritis, with hare-lip, 17.
Glanders, 517.
Glands, salivary, 44.
  malformations of, 44.
Glands, pineal, psammomas, 346.
Glioma, among children, 342.
  cerebellar, 342.
  cortex, cerebrum, 371.
Gliosarcoma, 376.
Glycosuria, 391.
Gumma, of brain, 364.
Harelip, 13, 15, 19.
Hay fever, nasal sinus disease, 424.
Head, injuries of, 47.
Headache, 217, 350, 417.
Hebetude, 217, 253.

Hemangioma, 538.
Hematoma, of scalp, 59.
under aponeurosis, 60.
in cheek, 65.
Hemicrania, frontal sinus disease, 440.
Hemiopia, 217.
Hemiplegia, 170, 217.
with hemispasm, 170.
contralateral, 182, 184.
collateral, 182.
Hemorrhage:
arm and leg centers, 88.
cerebral, 81, 336.
dangers of operating, 18, 27.
dural, 84.
extradural, 61, 181, 187.
middle meningeal artery, 81, 178, 185
sinuses, 81.
Hernia of brain, 2, 10, 116.
basilar, 10
Hernia, strangulated, 199.
Hydatid cyst, 345.
Horns, 535.
Hydrocephalus, 4, 33, 40.
brain tumor, 364.
Hyperesthesia, 217.
Hypertrophy, of face, 44.
Hypophysis cerebri:
tumor, 347.
Inanition, in harelip, 21.
Incision, Wilde's, 265.
Incus, removed, 286.
Index catalogue, 77.
Medicus, 77.
Infants, hemorrhage in, 6.
poisoned by iodoform, 7.
Infarcts, 209.
Inferior dental nerve, excision, 481.
Inflammation, symptoms of, 53.
external auditory meatus, 243.
Influenza, epidemic, 291.
Infraorbital nerve excision, 479.
Injury, brain, 112, 143, 172.
cranial nerves, 81, 130, 144.
prognosis, 130.
during birth, 64.
epilepsy, 396.
Injury, intrauterine, 2.
occipital lobes, blindness, 152.
of head, 160.
of the face, 64.
prefrontal region, 152.
Insanity, 393, 406.
etiology 408.
fractures, 408.
history, 407.
injury, 408.
symptoms, psychic, 408.
traumatic, 408.
trephining in, 407.
Instruments, 281.
Intussusception, of bowel, 199.
Intoxication 158.
Iris, congenital attachment to lens, 195.
Irrigation, of ear, 270.
Irritability, 217.
Keratitis neuroparalytica, 138.
Krönlein's posterior point for trephining, 189
Laceration, brain, 199.
Leucocytosis, 254, 329.
Lipoma, brain, 346.
diagnosis, 536.
face and scalp, 536.
orbit, 550.
Loss of consciousness, 357.
of vitality, 217.
Ludwig's angina, 522.
Lungs, edema, 86.
tuberculosis, 281.
Lupus, common sites, 519.
course, 520.
diagnosis, 520.
frequency, 519.
prognosis, 523.
relative to carcinoma, 521.
erysipelas, 521, 533.
Ludwig's angina, 522.
sarcoma, 522.
treatment, 523.
use of X-rays, 524.
Lymphangioma, 539.
congenital, 43.
Macroglossia, 499.

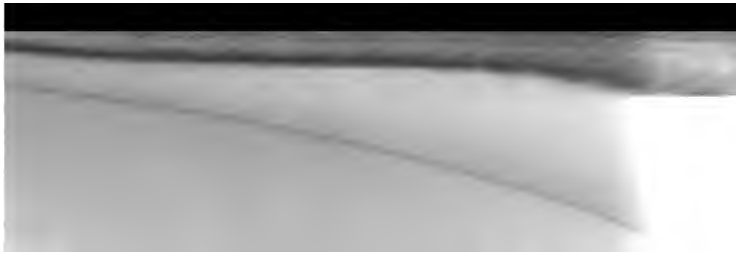
Macrostoma, 16.
Malar bone, fracture, 70, 74.
Malformations, congenital, 1.
  of head, 1.
  of mouth and face, 13.
Malleus, removed, 286.
Mastoid, antrum, 259.
  cells obliterated, 286.
  operation, 287, 421.
    dangers of, 282.
  sinuses, 247.
  suppuration, 290.
Mastoiditis, tuberculous, 308.
Maternal impressions, 22.
Maxims, malformations, 33.
  rupture middle meningeal artery, 199.
  scalp wounds, 58.
Meatus, aspergillus, 245.
  boils, 243, 244.
  circumscribed inflammations, 243.
  eczema, 245.
  external auditory, 243.
Membrana tympani, 263.
Meningitis, 246, 290, 291, 336.
  after cephalocele, 11.
  differentiated, 301.
  nasal empyema, 424.
  suppurative, 11.
  tuberculous, 452.
Meningocele, of nose, 3.
Microcephalus, 42.
Moles, 535.
Monospasms, 217.
Monster, acephalous, 1.
  congenital, 22.
  harelip, 19.
Motor areas, 129, 150.
  face, 151.
  leg, 151.
Mouth breather, 238.
Mumps, 457, 461.
Nasopharyngeal adenoids, 238.
  treatment, 240, 241.
Nerve, facial, 66, 125.
  cut, 66.
  separated 66.
Nerve, eighth, 140.
Nerve, fifth, 66, 137, 138.
    ophthalmic division, 137.
  ninth, 140.
  olfactory, injury, 131.
  optic, 132.
    extravasation, 134.
  seventh, 139.
  sixth, 138, 139.
    paralysis, 138.
  third, paralyzed, 135.
  trigeminus, 66.
  trochlear, paralysis, 136.
Neuralgia, 472.
  anatomy, 473.
  auto-intoxication, 475.
  diagnosis, 475.
  etiology, 472.
  nasal sinuses, 424, 431
  operations, 478.
  prognosis, 476.
  symptoms, 474
  treatment, 476.
Neuroma, of orbit, 550.
  case of, 550.
Neurasthenia brain tumor, diagnosis, 365.
Nose, cartilages, 70
  fractures, 70
  incised wounds, 67.
  meningocele of, 3.
  old fractures, 71.
  replaced, 67.
  sinuses, 423.
  tip of, 67.
  treatment, 70.
Nostril, obstruction, 70.
Occipital bone, fracture, 82.
Odor, putrid, breath, 295.
Operating table, 282.
Operation, cleft palate, 26.
  osteo-plastic, 200, 304.
  mastoid, 287.
  cerebellar abscess, 306.
Opisthotonus, 161, 162.
Opium, not used, 264.
Optic neuritis, brain tumor, 351.
  cerebral abscess, 296.
Orbit, abscess of, 547.

Orbit, tumor of, 550.
Orbital region, gunshot wounds, 68.
surgical diseases, 547.
Ossicles, granulations, 286.
Ossification, early, 42.
Osteitis, of face, 68.
protracted suppurative, 68.
Osteofibroma, inside cranium, 346.
Osteoma, inside cranium, 346.
Osteoplastic operation, 191, 200, 304.
Otic, abscess, 298.
complications, 306.
Otitis media, 247, 249, 251
anatomy, 255.
diphtheria, 252.
foreign body, 249.
frequency, source, 247.
latent, pyemia, 312.
scarlet fever and measles, 251.
treatment, 264.
Otorrhea, fetid 277.
Pachymeningitis hemorrhagica interna, 393.
diagnosis, 403.
etiology, 402.
histology, 405.
symptoms, 403.
Pachymeningitis, suppurative, 214.
Papilloma, of tongue, 499.
Paralysis, bladder, 183.
infantile, 336.
Paresis, general, 364.
pachymeningitis, 402.
Parietal bone, fracture, 82.
Parotid gland, 457.
abscess, 461.
adenoma, 469.
anatomy, 457.
angioma, 470.
carcinoma, 470.
fibroma, 470.
fistula, 67.
lymphangioma, 470.
mixed tumors, 469.
opened, 67.
retention cysts, 458.
suppuration, 460.
Parotid gland, tuberculosis, 466
tumors, 468.
Peptonuria, 217.
Pericranium, blood under, 59.
Philtrum, 14.
unusually deep, 19.
Phlegmon, face and scalp, 524.
with erysipelas, 529.
Pineal gland, psammomas, 346.
Pituitary body, endothelioma, 385.
extirpation, 391.
Pleurothotonos, 223.
Plexus of Santorini, 137.
Pneumatocele capitis, 63.
in compound fractures, 63.
in otitis media, 63.
treatment, 63.
Poison, infants, 7.
iodoform, 7.
morphine, 158.
suicidal, 159.
Politzer inflator, not used, 264.
Polypus, ear, 283.
Pott's puffy tumor, 87, 184.
Pressure, increased intracranial, 39.
Probe, dangerous, 55, 113.
Psammomas, pineal gland, 346, 347.
variety of endothelioma, 347.
Ptosis, 135.
Psychosis, head injury, 408.
Pulse, 217.
in brain tumor, 358.
slow, 217.
Pupils, dilation, 135.
unequal dilatation 217.
Pus, chronic abscess, 219.
Pyemia 68, 290, 307, 312.
Quincke puncture, 36.
Raynaud's disease, 34.
Retention cyst, 458.
etiology, 534.
of face and scalp, 534.
of lachrymal gland, 550.
of parotid, 458.
treatment, 535.
Retractor, automatic, 282.
Rhinoscleroma, 518.
diagnosis, 518

Rhinoscleroma, symptoms, 518.
treatment, 518.
Rickets, with cleft palate, 23.
with harelip, 23.
in hydrocephalus, 34, 40.
Rigors, 254, 292.
Saliva, germicidal properties of, 467.
Sarcoma, 43.
in adults, 342, 343.
brain, histologic structure, 344.
course, 545.
of face and scalp, 545.
frontal convolution, 355.
mixed tumors, 343.
relative to lupus, 522.
of skull, 545.
treatment, 546.
Scalp, anatomy of, 48.
complete removal, 56.
contusion, 59.
hematoma, 59.
veins of, 50.
Scalp wounds, 49.
before birth, 50.
coaptation of without stitches, 55.
course of, 52.
diagnosis, 53.
drainage, 55.
on drunkards, 54
erysipelas in, 55.
fractures of skull, 54.
incised, 50.
infected, 51.
maxims, 58
old, 51, 55
not retractile, 55.
small, 51, 95.
Sella turcica, 134.
Semicircular canals, 282.
injury, 282.
Sessile, cephalocele, 7.
Sigmoid, groove, 282.
Sigmoid sinus, 282.
thrombosis, 307, 309.
Sinuses dural, rupture, 167.
hemorrhage, 81.
lateral, 153, 157.
Sinuses, nasal, 423.
anatomy, 425.
sigmoid 153.
superior longitudinal, 153, 155.
wounds, treatment, 206.
(See accessory sinuses.)
Sinus thrombosis, 290, 309, 315.
differentiated, 301.
mistaken for other conditions, 330
nasal empyema, 424.
symptoms, 311.
Skin grafting, upon cranium, 56.
Skull, anatomy, 78.
anomolous, 11
Skull, fractures, 78, 85, 114, 180.
diagnosis, 86.
symptoms, 85.
treatment, 87.
Skull fracture:
of base, 79, 83, 108.
complicated, 79, 83.
course, 84.
depressed, 84, 104, 106, 198.
compound, 79, 83, 110.
contents, methods of locating in 154.
dura, attachment of, 177.
pachymeningitis, 403.
simple, 79, 82.
tenderness, brain tumor, 361
of vault, 79, 83.
compound fracture, 92
Soap, Schleich's marble, 281.
Speech center, 151.
Sphenoidal sinus, 446.
empyema, 447.
diagnosis, 447.
Kitterman's operation, 448
Sponges, 282.
Squamosal sinuses, 247.
Squamous cells, obliterated, 286.
Stapes, left behind, 286.
Steiner's second point for trephining 189.
Stenson's duct, 67, 458.
fistula, 67.
Sterterous breathing, 161.

Stupor, after cranial injury, 171
Subperiosteal abscess, 269.
Supraorbital nerve, excision, 478.
Sugar, in cerebro-spinal fluid, 11.
Suppuration, within cranium, 158.
Suprameatral triangle, 285.
Symptom-free interval, 181.
Syphilis, eyelid, 513.
face and scalp, 512.
hereditary, 34.
in hydrocephalus, 39.
of lip, 514.
Tachycardia, brain tumor, 358.
Teeth, Hutchinson's, 41.
Temperature, abnormal, 217.
Temporal bone, fracture, 82.
Tempero-sphenoidal lobe, 156.
Tenderness, skull, brain tumor, 361.
Tendon reflexes, 153.
Tetanus, 517.
Thrombosis, infected, 209.
sigmoid sinus, 309.
Thymus gland, epilepsy, 397.
Tiersch, shin grafts, 69.
Tissues, replanted, 67.
treated aseptically, 67.
Tracheotomy, before operation, 25.
Trauma, acute mania, 90.
Trephining, indications, 170.
contra-indications, 171.
insanity, 407.
Triangle, suprameatral, 285.
Trigeminus, injury, 66.
Tuberculosis, lungs, 281.
mastoiditis, 308
Tumor, brain:
childhood and adults, 336.
diagnosis, 361.
differential, 363, 364.
duration, 375.
epilepsy, 393.
etiology, 348.
localizing, 359.
location, 336, 338.
symptoms, 349, 351, 357, 358.
Trauma, 349.
treatment, 341.
Tumor, brain:
carcinomatous, 337.
cerebellar, 340.
cerebral, 336, 337.
cortex, 340.
cystic, 337, 345.
gliomatous, 337.
glio-sarcomatous, 337.
inoperable, diagnosis, 338.
sarcomatous, 337.
syphilitic, 337, 345, 348.
tuberculous, 337, 345.
Tumor, face and scalp, 534.
carcinoma, 540.
fibroma, 537.
hemangioma, 538.
lipoma, 536.
lymphangioma, 539.
moles, warts, horns, 535.
neuroma, 550.
osteoma, 553.
retention cysts, 534.
sarcoma, 545.
Uranoschisma, 23.
Uranocolobom, 23.
Uremia, brain tumor, 364.
pachymeningitis, 403.
Uvula, double, 19.
Ventricles, lateral, 229.
Vertex, fracture, 93.
Visual, cortical center, 129.
Vomer, 15.
Vomiting, 217, 292.
brain tumor, 357.
Warts, 535.
Wens, 535.
Wilde's incision, 265, 276.
Word deafness, 129.
Wounds, gunshot, 68.
optic foramen, 133.
orbital, 133.
of sinuses, treatment, 206.
treatment, 58.
blood, 65.
drainage, 65.
of face, 65, 66, 68.
gunshot, 217.

Wounds, treatment, hemorrhage, 65.
perfectly coaptated, 66.
punctured, 66.
rules, 58.
stabs, 66.
X-rays, 218.
Zygoma, fracture, 71, 74, 76.
complicated, 75.
compound, 75.
uncomplicated, 75.
simple, 75.



PRINTED BY R. R. DONNELLEY
AND SONS COMPANY, AT THE
LAKESIDE PRESS, CHICAGO, ILL.

LANE MEDICAL LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

M521 Holmes, B.T.
H74 The surgery of the
1903 head. 46903

NAME | DATE DUE